AD-A181 466 COST ANALYSIS FOR AIRCRAFT SYSTEM TEST AND EVALUATION: EMPIRICAL SURVEY D..(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA W J FOSTER ET AL. MAR 87 1/3

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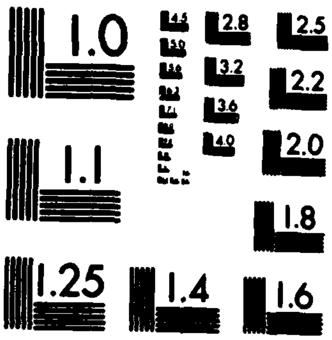

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

COST ANALYSIS FOR AIRCRAFT SYSTEM TEST AND EVALUATION: EMPIRICAL SURVEY DATA STRUCTURING AND PARAMETRIC MODELING, VOLUME II

by

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and

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March 1987

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A181466

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY 2b DECLASSIFICATION / DOWNGRADING SCHEDULE	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b OFFICE SYMBOL (If applicable) 54	7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c ADDRESS (City, State, and ZIP Code) Monterey, California 93940-5000	7b ADDRESS (City, State, and ZIP Code) Monterey, California 93940-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION Naval Air Systems Command 8b OFFICE SYMBOL (If applicable) AIR-5243	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code) Jefferson Plaza 2 Washington D.C. 20361	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO · PROJECT NO · TASK NO · WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
COST ANALYSIS FOR AIRCRAFT SYSTEM TEST AND EVALUATION: EMPIRICAL SURVEY DATA STRUCTURING AND PARAMETRIC MODELING, VOLUME II

12 PERSONAL AUTHOR(S)
Foster, William J. and Moore, Walter J. Jr.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Master's Thesis	FROM ______ TO ______	March 1987	256

16 SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Aircraft, Financial Management, Materiel Acquisition

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

There is an increasing requirement from high levels within the Government that the Navy's aircraft cost estimators and analysts provide explicit estimates for the sub-elements of Aircraft System Test and Evaluation (AST&E) efforts. The data required to produce more accurate and detailed estimates represent lower levels in the Aircraft Work Breakdown Structure (WBS) than previously available. This is a two volume thesis. Volume I examines the WBS and Contractor Cost Data Reporting (CCDR) system with a description of current reporting practices and implementation shortcomings. Recommended courses of action to improve reporting requirements and thereby improve data quality and cost estimates

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a NAME OF RESPONSIBLE INDIVIDUAL Tung X. Bui	22b TELEPHONE (Include Area Code) 646-2639 22c OFFICE SYMBOL 54Bd

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete. SECURITY CLASSIFICATION OF THIS PAGE

(19. continued)

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Cost Analysis for Aircraft System Test and Evaluation: Empirical Survey, Data Structuring and Parametric Modeling Volume II

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MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

There is an increasing requirement from high levels within the Government that the Navy's aircraft cost estimators and analysts provide explicit estimates for the sub-elements of Aircraft System Test and Evaluation (AST&E) efforts. The data required to produce more accurate and detailed estimates represent lower levels in the Aircraft Work Breakdown Structure (WBS) than previously available. This is a two volume thesis. Volume I examines the WBS and Contractor Cost Data Reporting (CCDR) system with a description of current reporting practices and implementation shortcomings. Recommended courses of action to improve reporting requirements and thereby improve data quality and cost estimates are proposed. Major cost drivers for AST&E, from both the perspective of Defense Contractors and Military Flight Test Centers, are discussed. Beginning in Volume II, a relational data base system is introduced to more easily evaluate AST&E cost elements and physical/performance characteristics. A Contractor Flight Test cost estimating relationship (CER) is developed through step-wise multiple regression analysis of data gathered from Defense Contractors and Naval Air Systems Command (NAVAIR).

TABLE OF CONTENTS

I. SURVEY OF CURRENT DATA AND STRUCTURE

A. INTRODUCTION

All companies interviewed provided data in some form or another. Some data were better and more complete than others. Not all aircraft data requested were provided. Various reasons were given, including, (i) data too old and not available or would not be of use; (ii) aircraft were commercial derivatives and flight test data not applicable; or (iii) data were for internal use only. A synopsis of the data received, by company, is included below. This summary includes: the type of aircraft reported against, how much data was given, what form the data was in, and a short overview of the companies data collection methods.

B. DESCRIPTION BY CONTRACTOR

1. Boeing

Boeing's initial data include a breakdown of the B-52 and the KC-135 aircraft. Flight Test, Wind Tunnel Test, Static Test, Fatigue test, Flight hours, Wind Tunnel Occupancy Hours and other data were provided. The flight test data were time phased. In the case of the B-52, only block 1 aircraft were time phased, available from 1952 through 1958 in six-month intervals. With the KC 135 six-month interval data blocks 1 through 4 aircraft were

included ranging from 1953 through 1959. For wind tunnel static and fatigue test, only data for the B-52 were provided. Flight test hours were provided by serial number, and wind tunnel occupancy hours were given for both B-52 and KC-135. Other data include the B-52 prototypes flight test and mockup hours. Other KC-135 data include other block 1 data, i.e., maintenance trainers, support equipment, static test, wind tunnel test, airframe and structure ground test, avionics ground test, other ground test, other system test, class I M/U, class II M/U, and class III M/U. Graphs were plotted in the section on wind tunnel occupancy to show the time phased usage of the wind tunnel. Additional Flight test and Wind Tunnel data on the KC-135-1, XB-52, YB-52 and YC-14 were provided.

All the data given was stored in a historical data base within the company owned and developed called Executive Information System (EIS). This system is a matrix-type structure with cost elements and programs forming the parents with many children, matched against the Work Breakdown Structure (WBS) down to the fifth level elements (see Figure 1-1). All cost data is from the official company accounting system and auditable to work in progress ledgers. Data can be retrieved per user desired reports or formats in tabular or graphic display (i.e., total man-hours by cost element (CE), detailed manhours (CE/WBS),

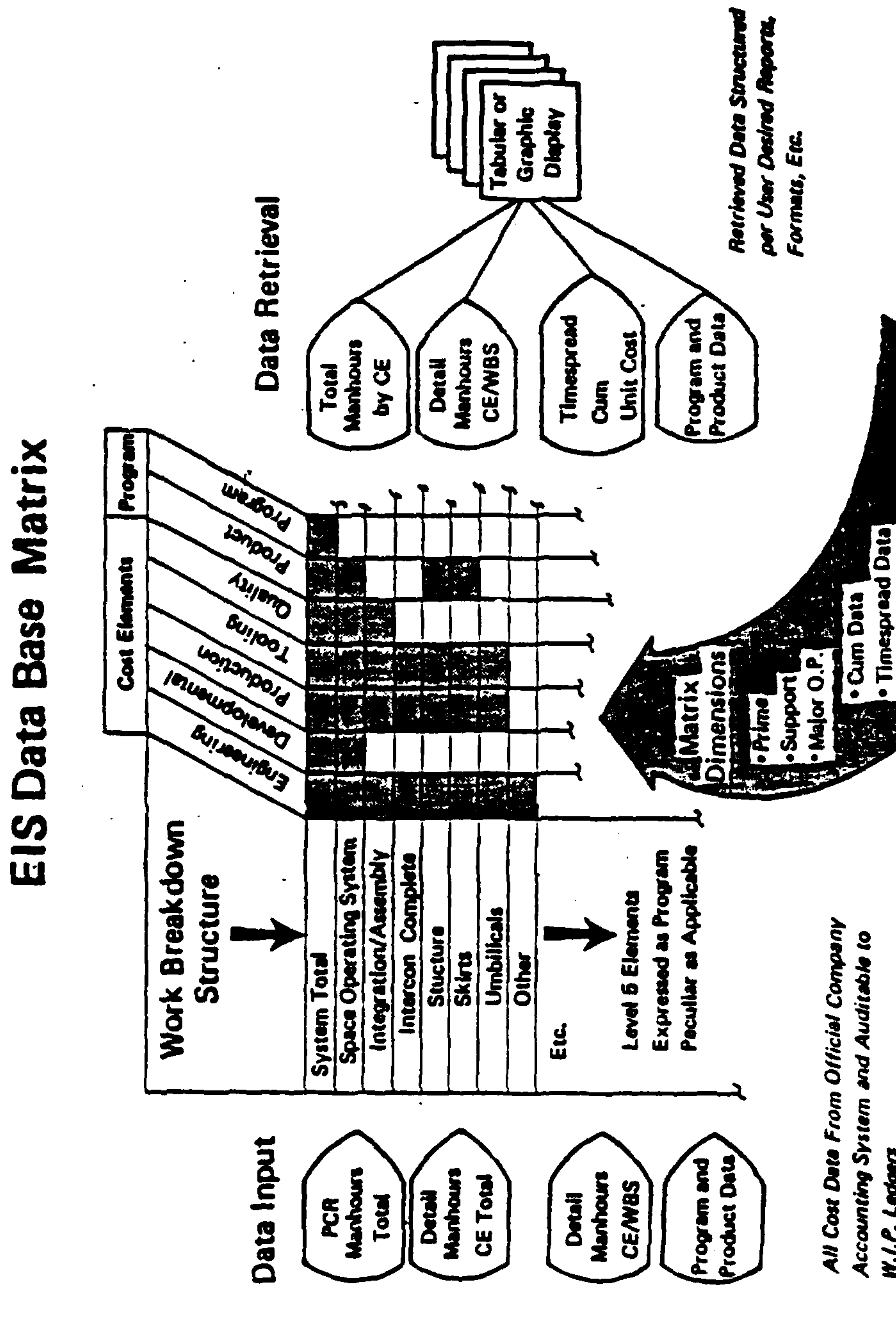


Figure 1-1. EIS Data Base Matrix

time-spread cumulative unit cost, and program and product data). Boeing also has a current on-line system to handle ongoing projects. Once these projects are completed, the information is transferred to the historical data base.

2. Rockwell International, Columbus

Rockwell Columbus provided data on the A-5A, OV-10 and the T-2. Data included total hours and dollars for Contractor Flight Test, Wind Tunnel, Static and Fatigue Test. Contractor Flight Test and Wind Tunnel were not broken down into any sub-elements; Static and Fatigue Test did not include the Engineering hours for the article test. Flight hours are time phased. Engineering and manufacturing hours are the only hours reported.

It was not understood whether or not Rockwell has an computerized data base. If they do, it is not likely real time since definitions are not standard through the company.

3. Fairchild Aircraft

Fairchild provided data on the F-105. Information was given on engineering paper and looked to be a copy of the total records kept of the aircraft. Fairchild does not have a data base. All records are apparently kept by hand. Like Rockwell, the definitions are not standard company wide.

4. Grumman Aerospace Corporation

Grumman provided data on the F-14. Initially, cost data only were provided. Later, a detailed breakdown of the

system test and evaluation for Contractor Flight, Static, Wind Tunnel, and Fatigue test were offered, together with a Test to Cost Study performed by the Flight Test Department which included extensive information relating to the F-14 and other aircraft.

Grumman has a data base and a standard accounting system. Data are structured down to Level 9 of the WBS in the data base. Grumman uses the contract dictionary down to Level 5 or 6. Data below Levels 5 and 6 are defined by Grumman's Planning and Controls section. The company's definitions are standardized.

5. Rockwell International, Los Angeles

Only cost data on the B-1 were provided by Rockwell L.A.. Cumulative system test hours were made available for Static Test and Fatigue Test. These hours were broken down by unit number.

Rockwell has a computer data base accounting system. During the interview, they did not share any detail on its level of information. We were referred to the Air Force system project office for all our data requests. We were only provided dollar figures on the CCDR required reports.

6. LTV Aerospace and Defense

LTV delivered data on A-7, TA-7, XC-142A, F-8U and as a sub-contractor, S-3A and C-17. Of these, statistics on the A-7 and the TA-7 were abundant. Flight hours were time phased starting in September 1965 for the A-7 and December

1976 for the TA-7. Labor hours were divided into engineering and manufacturing, and reported for Instrumentation, Flight Test Spin Program, Night and Delivery, and Misc. For the TA-7, labor hours were not divided between engineering and manufacturing. Total hours were reported against the same items as the A-7 except for an additional item reporting category of General Flight Support.

The company's financial management department maintains the WBS to the third level. The Work Management System is a system listing by task and correlates to WBS sub-tasks. LTV does not currently have a data base that allows for retrieval of historical data by cost element. Work is in progress to implement such a data base system.

7. General Dynamics Corporation

General Dynamics provided data on the YF-16, F-111, F-16 and the B-58. Data included hours and dollars for Direct Labor Hours, Administration, Engineering, Tooling, Manufacturing, Mod and Test, Electric Fabrication Center, Q.A. and Production Support. Only dollar figures were reported for Overhead, Material and Subcontract, Material Burden, Other Direct Charges and General and Administrative Expense. In addition, a Program Overview was given along with Aircraft Characteristics, Program Unique Features, Schedule Data, and WBS Definitions.

General Dynamics maintains a company-wide MIS with matrix translation to input individual project cost data. This system captures actual cost data with dollars normalized to a midpoint for the cost period. The internal data base is used to establish cost estimation relationships.

8. McDonnell Douglas Corporation

McDonnell Douglas provided a schedule for the Static Airframe, Fatigue Airframe, and Fatigue Test Article development. They also provided a historical F/TF-15 Category I Flight Test Plan, but no data was released.

WBS accounting is kept at one level below contract requirements. If contract is at Level 3, internal records will be maintained at Level 4. Their current data base maintains information at the following levels:

- Job order--large component level
- Item level--segregates major tasks (i.e., fatigue testing)
- Cost code--sub-task of item level (i.e., forward fuselage side panel).

Cost accounting is standardized company wide in a corporate data base system used by McDonnell Douglas with each sector of the company records are maintained separately in sub-groups for specialized information.

9. Lockheed Georgia Company

Lockheed released data on the C-5, C-141 and a limited amount on the C-130. The C-5 data was broken down

by Production Manhours, Engineering Manhours, Tooling Manhours, and Material Dollars. In addition, a description of the WBS used on the C-5 was provided. The C-141 data was broken down by Engineering Manhours, Tooling Manhours, and Material Dollars. A WBS description and a test and update highlights chart was provided. The limited data on the C-130 included total flight hours, number of months from 1st flight to completion of tests, and average flight hours per month.

Cost items are tracked by work order, subdivided into major class, minor class, and suffix. Suffix data has been used by different divisions of Lockheed Georgia for their own data tracking, complicating insertion of lower level cost elements into a standard company database. The work order information generally follows the work breakdown structure format. The accounting and record keeping department utilizes Boeing's information system shell to support the internal data structures. The Tops (terminal on-line pricing system) will work with the Glides (GELAC Integrated Data Bank Estimating System) system for cost estimating and analysis. As this system is fully implemented, the outer ring or system shell will be standardized company-wide. The inner ring will be tailored for departmental use. Due to differences in past job order tracking, a significant amount of time has been spent in standardizing cost data. For government contracts, they use

the Sentinel system (Cost schedule control system) to track CCDR reporting requirements only. This was the basic system previously used to track work order information.

10. Lockheed California Company

Lockheed California provided data on the S-3A, this data was given in hours and dollars. Data was provided for the majority of the requested catagories. Flight hours were provided by aircraft. Engineering hours were further broken down into subcategories of the WBS.

Cost items are tracked the same as with Lockheed Georgia except that an on line data base is expected to be operational in the near future. At present, historical test data is maintained separately for each major program and not standardized company wide.

11. Naval Air Test Center

It was intentional not to gather data from the Naval Air Test Center. However, some information on an accounting system that is to be introduced in March 1987 were made available. This system is called STAFS (Standard Automated Financial System). It is not used as a real time data base and will not provide real time access to System Test and Evaluation type data.

12. Air Force Test Flight Center

The Air Force Test Center provided data on the B1-B, F-15 and the F-16. Units (hours); actual and estimated, dollars; estimated total, actual total, estimated

reimbursable and actual reimbursable were reported for job order numbers. Cost-centers were broken down by JON (job order numbers), PIN (product identification number), REN (resource identification number), and EEIC (elementary element identification code).

This test center is unique in that it is a Combined Test Facility. Contractors and the test center share data collected on System Test and Evaluation aircraft. Contractors do their testing on site using the Test Centers facilities.

The Air Force Test Flight Center uses an accounting system called MISTE (Management Information System for Test and Evaluation). This system tracks and updates the test data according to the JON, PIN, REN, and EEIC numbers. It also provides the capability to create reports, standard and nonstandard.

13. NAVAIR

Additional information was provided by NAVAIR. This data was on the S-3A aircraft and came from the NAVAIR data base where the CCDR report information is held. The data was time phased in six-month intervals, standardized and reported against the WBS. This information was used as a tool to evaluate the other S-3A data.

C. SUMMARY

All data furnished can be used, however for the initial analysis, only test labor hours, as opposed to dollars, are appropriate. Therefore Rockwell's cost data will not be utilized. Also the data contributed by the Air Force Test Flight Center is not appropriate because of the inability to distinguish between Contractor Flight Test and Operational Flight Test.

Data furnished by the contractors need to be standardized and compared to the individual companies' CCDR reports held at NAVAIR before they can be used for statistical purposes. Once this task is accomplished, the data could be ready for analysis. However to facilitate the analysis process, the data should be re-arranged in a cohesive and consistent framework. This could be accomplished by developing a data base structure where data could be maintained. This would also facilitate the ease of use as well as the analysis.

II. A SURVEY OF PARAMETRIC TECHNIQUES FOR ESTIMATING COST OF AIRCRAFT SYSTEMS

A. INTRODUCTION

A parametric equation which is derived from theoretical considerations is called a model. The parameters occurring in a model usually represent quantities that have physical significance. The validity of a model rests on the procedures used to obtain values of the parameters, e.g., estimators that not only fit the data well, but also come, on the average, close to the true values and do not vary excessively from one set of experiments to the next. The process of determining parameter values with these statistical considerations in mind is termed model estimation. The utility of parametric estimation models has been effectively applied to several branches of science. (BARD, 1974, pp. 15-16) These parametric techniques are also applicable to the area of cost estimation.

Parametric cost estimating, when applied to aircraft systems, primarily utilizes physical and performance characteristics, as well as costs of previously procured items to identify the anticipated costs for a new system. A combination of system parameters, such as physical dimensions, weight, speed, etc., can be related to the total system cost. Relationships can be established in the form of mathematical equations and are referred to as Cost

Estimating Relationships (CERs). Cost elements, such as labor hours, are chosen as the dependent variable in a CER. System parameters are evaluated as independent variables in the relationship. These parametric methods can be applied to individual segments of a system life cycle or estimations can be aggregated to reflect a composite--resulting in total system cost. In the acquisition of aircraft systems, parametric cost estimating lends itself readily to developing relationships before the details of design are certain. Cost comparisons on alternative designs can also be evaluated early in the preliminary design stage as varying parameters of system cost are tested. Parametric cost estimating is a possible tool, provided accurate and sufficient data is available to evaluate the aircraft physical characteristics, performance tradeoffs, and cost impact alternatives.

Several research studies have applied parametric cost estimating methods to develop models for aircraft systems. Included are two studies that focus on software and avionics estimating methods.

B. PARAMETRIC COST ESTIMATION STUDIES

1. Planning Research Corporation (PRC R-547-A) April 1967

An early excursion into estimating airframe development and production costs was attempted by the Planning Research Corporation (PRC). The study centered on

developing suitable techniques for use in program planning, cost-effectiveness studies, and evaluation of contractor proposals. This model consisted of three separate cost elements: direct manufacturing labor, manufacturing materials, and engineering and tooling (aggregated as a single element). Tooling and engineering costs were combined in order to separate recurring and nonrecurring costs for these two categories. (Sanchez, 1967, p. I-1) The model was developed by stepwise regression on a sample of forty-one propeller driven and turbojet aircraft dating from as early as 1940. Aircraft characteristics used as independent variables included speed, weight, and functions of these (e.g., speed squared). Production program characteristics included quantity produced, delivery rate, and a weight growth factor. Contractor discontinuity variables were used to represent differences in accounting practices. Time-related characteristics expressed changes in the technological state-of-the-art from 1940.

Separate estimating equations were developed for each cost element at production unit quantities of 10, 30, 100 and 300. These estimates were then used to derive cost-quantity curves to enable cost estimation for a desired quantity of production. Graphed on a logarithmic scale, the four units of production estimate points were analyzed with best fit straight line through the vertical axis. This log-linear functional form was used to provide an estimate

for a single unit of production. Twelve equations were developed, four for each cost element across the levels of production, to derive three cost estimating curves. The evaluation of separate levels of production allowed for derivation of a learning curve to be expressed in unit costs. This provided for a more uniform procedure to be applied for aggregating cost elements into total costs. (Sanchez, 1967, p. I-6)

The study did not develop separate cost equations for prototype and production aircraft. The sample data utilized a wide variety of aircraft types, period of development and production, and range of manufacturing technology.

2. RAND (R-761-PR) February 1972

This report provided a set of relationships for estimating costs of military aircraft airframes in a long-range planning context. The relationships included costs of development and production with a separate set of CER equations for prototype aircraft development. The cost elements used in developing these relationships included engineering, development support, flight test operations, tooling, manufacturing labor, manufacturing material, and quality control. (Levenson, 1972, p. 1)

The relationships were obtained through analysis from data on post-World War II cargo, tanker, fighter, bomber, and trainer aircraft. The aircraft were of aluminum

construction with range in speed from low subsonic to Mach 2.2. The data sample included production programs from ten different defense contractors. The estimating equations were derived by statistical multiple regression techniques. These techniques related costs or man-hours to aircraft physical and performance characteristics and to airframe production quantity. Although other potential equation forms and explanatory variables were considered and tested, exponential regression equations primarily used three independent explanatory variables: **aircraft weight, speed** and **quantity**. These three variables provided the most useful relationships for the cost elements evaluated. Little or no predictive improvement was gained by including additional physical and performance variables in determining total airframe costs. (Levenson, 1972, p. 3)

Flight test operations were evaluated as a separate cost element and comprised all costs incurred by the contractor to carry out flight tests except the cost of test aircraft. Flight test operations costs were available for 27 aircraft. Data on several aircraft were not consistent with the majority of the sample. However, because no systematic criterion for rejecting specific aircraft was apparent in the sample, the complete sample was used.

Flight test operations cost was related to speed, weight and number of test aircraft with the resulting equation (Levenson, 1972, p. 14):

$$F = .001244 \quad A^{1.160} \quad S^{1.371} \quad Q^{1.281}$$

coefficient of correlation (unadjusted) = .97

coefficient of variation = 34 percent

where F = flight test operations cost in 1970 constant dollars

A = AMPR weight (lb)

S = maximum speed at best altitude

Q = number of flight test airframes

The uncertainty in predicting costs was addressed by this study. Since cost estimation is frequently treated as an attempt to obtain a best single-valued prediction of the cost of a new item, a level of confidence assigned to the cost equation may explain variations between initial predictions and the actual cost outcome. Factors that account for these variations may be analyzed to assess this confidence. Three primary sources of cost estimation uncertainty occurring in aircraft systems acquisition were indicated as:

1. Changes requested by the customer
2. Difficulties encountered by the contractor
3. Statistical uncertainty inherent in the estimating method--e.g., uncertainty due to failure to include all of the relevant independent variables, uncertainty due to inherent randomness in the process being modeled.

The study maintained that the effectiveness of a parametric cost model could only be analyzed with respect to the third source of uncertainty. The effects of the first two sources

of uncertainty on the validity of a model could possibly be observed by analyzing the planned weight and speed against actual weight and speed of the finished aircraft in the regression model. (Levenson, 1972, p. 33)

3. J. Watson Noah Associates (FR-103-USN) September 1973

The original intent of this report was to examine aircraft Research and Development costs and derive cost relationships for their estimation. Due to the difficulty in isolating historic R & D costs, production costs were also examined.

Data from thirty-five aircraft systems were included in the research study. Airframe cost elements included engineering, tooling and manufacturing labor, and materials costs. The costs were divided into non-recurring and recurring costs. The non-recurring costs included primarily much of what is considered as Research, Test, Development and Evaluation.

These cost estimating relationships were developed using multiple regression analysis through several logical steps. First, a large number of variables in different combinations and functional forms were screened. An examination of conventional regression statistics resulted in the elimination of several alternatives. The preferred CER was developed and a prediction interval computed. The equation was then used to predict known costs for one or

more aircraft which had been temporarily excluded from the data base as a form of validation and verification. If these results proved satisfactory, then all of the observations were included in the CER development and the coefficients were reestimated. (Noah, 1973, pp. 44-45)

The following candidate variables for non-recurring airframe costs were selected:

S = Maximum Speed

A = AMPR Weight

R = Ratio of gross takeoff (GTO) weight to AMPR weight

T = Technology Index

D = Complexity Dummy

Aeronautical Manufacturers' Planning Report (AMPR) weight provided a standard for consistent evaluation. Maximum speed was used for an aircraft's best altitude. Gross takeoff weight represents design gross weight for an aircraft's primary mission. The technology index variable explained the changes which occurred in airframe manufacturing technology through time trends. The complexity dummy variable was included because the CERs underestimated the costs of four aircraft (F-102, F-106, B-58 and F-111). The use of the dummy variable was justified for these aircraft due to mission or performance parameters which required significantly new and complex technology. (Noah, 1973, pp. 47-48)

The non-recurring airframe costs relationship, derived through regression analysis, resulted in the following CER predictor:

$$\text{Cost} = -5.945 + \underset{(6.43)}{.00663\,S} + \underset{(1.645)}{.05138\,T} - \underset{(3.18)}{1.4071\,R} + \underset{(7.54)}{6.74926\,D}$$

$N = 32$

$R^2 = .847$

Numbers shown in parentheses are t-ratios expressed in absolute value. All logarithms are understood to be to the base 'e'. (Noah, 1973, p. 66-67)

Cost estimation relationships for separate elements of airframe non-recurring total costs were not developed in this model.

The significance of avionics cost in aircraft system development with a current lack of avionics CERs to estimate either development or production costs was addressed in this study. Avionics CER development had not been successful up until that time due to poor data availability and quality. The study recommended categorization and reporting of avionics costs by function through required contractor cost reports.

4. RAND (R-1693-1-PA&E) May 1975

The cost estimation model developed in the 1972 RAND study (R-761-PR) elicited user concern centering on three perceived shortcomings of the model: (1) the only two major explanatory variables were weight and speed; (2) all aircraft were lumped together rather than treated as

separate classes; and (3) no provision was made for taking into account changes in airframe structural materials and manufacturing methods. (Large, 1975, p. 2) As information on several new aircraft became available, the Office of the Assistant Secretary of Defense -Program Analysis and Evaluation (OSD-PA&E) sponsored a new RAND study to address these problems. The study plan called for:

1. Review of airframe data in the RAND files to ensure accuracy and consistency of definition and acquisition data on new aircraft

2. Consideration of additional explanatory variables that would make the model better able to deal with characteristics peculiar to individual aircraft, e.g., variable-geometry wing, oversize fuselage

3. Examination of the cost impact of major changes in manufacturing technology over time and of the use of different structural materials. (Large, 1975, p. 2)

In the time available, all questions concerning data consistency were not resolved. Their search for other explanatory variables that would improve the accuracy of estimates were less fruitful than they hoped. The variations in cost that were not explained by weight and speed were not explained by any other objective indexes that they could find. Since the data sample consisted largely of aluminum aircraft, the shift to other materials such as steel, titanium, and composites raises a question about the value of equations derived from that sample for estimating the cost of future aircraft. Some qualitative considerations were addressed concerning a statistical

analysis trend toward higher material costs and reduced manufacturing man-hours.

The estimation model developed was similar to other RAND models in that it allowed estimates to be made of individual cost elements. The study contends that results obtained from individual cost estimates are comparable to the accuracy achieved by estimating at the total program level recommended by the 1973 Noah study (FR-103-USN).

An attempt to analyze the data sample by aircraft type (bombers, fighters, cargo aircraft, etc.) was addressed. Despite the intuitive appeal of stratifying the sample in that way, two factors discouraged this approach. First, when the data were plotted, no natural boundaries appeared. Trainers were mixed with fighters, fighters with bombers, and bombers with cargo aircraft since many category types were similar in both weight and speed. Second, the sample size for individual aircraft types was too small to be representative except in the case of fighters. They held that in cost estimation, as is usually the case, the new aircraft will be substantially different from the historical data base and it is better to have a larger group of more diverse aircraft as a data sample.

Numerous explanatory variables that could impact aircraft development cost were evaluated. Seventeen separate physical characteristics were considered as possible variables for analysis. Other factors influencing

program cost were explored: **schedule, management, funding, state-of-the-art advance, availability of labor, investment in capital tools**, and **time**. However, these factors were considered to be inconsistent and not appropriate to a parametric cost model based on data from a wide assortment of programs insensitive to small changes. (Large, 1975, p. 14)

Utilizing a stepwise least-squares procedure, the explanatory variables were evaluated. The most statistically significant characteristics and dependable predictors of cost remained **weight** and **speed**. (Large, 1975, p. v)

Flight test costs were also addressed in this study as a separate cost element. The independent variables found to be significant here, other than weight and speed, were the **number of flight-test aircraft** and a **dummy variable** to distinguish between cargo aircraft and all other types. The rationale for the dummy variable focused on added cost of instrumenting the test aircraft as an important portion of flight-test cost. Thus, cost should increase as the number of aircraft increases. Cargo aircraft supposedly require less flight testing than fighters and bombers due to a relative complexity factor, so cargo aircraft flight test costs would be lower. The flight test estimating equation was presented as follows (Large, 1975, pp. 36-37):

where FT = Flight Test Cost (1973 $ in Thousands)

Wt = Airframe Unit Weight (lb)

Speed = Maximum Speed (kn)

N = Number of Test Aircraft

DV = Dummy Variable (2 - Cargo, 1 - All others)

$$FT = \underset{(.99)}{.13(Wt)^{.71}} \quad \underset{(.92)}{(Speed)^{.59}} \quad \underset{(.99)}{(N)^{.72}} \quad \underset{(.99)}{(DV)^{-1.56}}$$

$$R^2 = .81$$

The number under each independent variable is the level of significance of that variable.

The study provided a suggested direction for future research emphasizing not only deterministic physical and performance characteristics but also trying to understand the influence of program differences. Factors such as **schedule, experience, efficiency, economic conditions, labor scarcities**, and all other contractor and governmental concerns do have a cost impact on each individual aircraft system acquisition. (Large, 1975, pp. 53-54)

5. RAND (R-1854-PR) March 1976

This report described the development of a substantially revised RAND computer model, DAPCA III (Development and Procurement Costs of Aircraft), which superceded the previous version reported in RAND report R-761-PR. This model is based partially on airframe methodology described in R-1693-1-PA&E with all airframe costs calculated as functions of airframe unit weight and

maximum speed at best altitude. Other explanatory variables found to be significant were time of first flight for manufacturing labor and for manufacturing materials, and the dummy variable for cargo or non-cargo aircraft in flight test cost. (Boren, 1976, p. 2)

No cost estimation relationships were developed for avionics packages to be included in the total system cost. Avionics development cost was entered into this model only as a throughput. Estimations for follow-on avionics packages were adjusted to follow a 95% learning curve factor since the package usually consisted of old as well as new equipment.

6. TRW Defense and Space Systems Group (ASD-TR-80-5025) September 1980

This study does not address the acquisition of the total aircraft system, rather it focuses on the **software cost analysis** and estimating procedures of **avionics operational flight programs (OFP)**. It assumes limited knowledge of the software product in the early planning phases, increased knowledge before the release of the Request For Proposal (RFP), and more complete knowledge at the time of proposal evaluation and source selection. (Wolverton, 1980, p. 1) Several cost estimating methodologies and alternatives were provided to support and evaluate the validity of an initial cost estimate.

The study reviewed five traditional approaches to software cost estimation. The approaches described were

top-down, similarities and differences, ratio, standards, and bottom-up estimating. It was recommended that two approaches should always be used in order to cross-check one against the other. This provided a systematic basis that would account for any observed difference in the total cost.

Four cost estimating models, that could be utilized for initial estimates or cross-checking, were described by purpose, input, computational procedures, and output. These models, believed to be most useful, included: Boeing Computer Services Cost Model, IBM Walston-Felix Cost Model, Putnam's Software Life Cycle Cost Model, and RCA PRICE Software Cost Model. These parametric estimation models predominantly use a combination of the following inputs: units of delivered source statements, lines of source code, number of source instructions, type of software to be developed, programming language and programmer skill, programming techniques, labor cost, available manpower or similar type descriptors. Utilizing various parametric techniques, the models provides cost estimation information in the form of man-month requirements, project duration, development cost, time phasing of effort, and sensitivity analysis to adjusted input variables.

The study recommends that each separate cost estimate be verified through comparison with an alternate prediction method.

7. RAND (N-1685-AF) March 1981

This research project was directed at providing cost estimating methods and relationships for both whole avionics suites and individual avionics systems for combat aircraft. The study centered on a sample of 17 combat aircraft and the avionics equipment installed in each. Possible explanatory variables were selected based upon interview inputs from defense contractors. Multivariate regression analysis techniques were used to evaluate potential CERs for both whole suites and individual avionics systems.

The explanatory variables determined to be most statistically significant for the avionics suites were:

1. Aircraft Empty Weight
2. Avionics Suite Weight
3. System Power Requirements (kilovoltamperes)
4. Avionics Suite Volume
5. Year of First Flight (technology variable)
6. All-weather capability dummy variable.

Four individual cost estimating relationship equations were developed based upon aircraft characteristics, avionics suite weight, avionics suite volume, and avionics suite power requirements. (Dryden, 1981, pp. v-vi)

Analysis of individual avionics systems, broken down into 11 functional groups, did not yield cost estimating relationships that were as robust as those provided for a whole avionics suite. This grouping provided relatively

homogeneous subsamples with potential estimating relationships based on weight, volume and power variables. A technology variable added little to the effectiveness of tested relationships with an undesirable amount of unexplained variance remaining.

A major problem expressed in this study was the difficulty in capturing and representing the rapid change characterizing the electronics technology of avionics. Advances in that technology have consistently led to the accomplishment of more individual functions per unit size of avionics equipment. To meet increasing mission requirements, more functions have been included in the design of avionics suites with an overall increase in total cost. (Dryden, 1981, p. 2)

C. SUMMARY

The studies discussed in this chapter were developed to provide parametric cost estimating models for both development of total aircraft systems and separate cost elements of those systems. The models describing airframe costs were developed as long ago as 1967. Avionics and software costs have emerged as growing elements in the acquisition of new aircraft systems. All of these cost models were developed through multiple stepwise regression using various size databases. The statistical samples were updated and evaluated with newer aircraft designs as

manufacturing methods and materials also changed. Despite the difference in samples and statistical approaches each study used for estimation, the two primary aircraft characteristics or variables/drivers for airframe cost remained weight and speed. Comparing airframe design alternatives for a new aircraft system, cost and performance tradeoffs could not be readily identified by using current estimation models unless weight and speed are significant factors in the analysis. Figure 2-1 compares four airframe cost studies by identifying cost elements and independent aircraft characteristic variables. Other physical and performance characteristics provided the most easily quantifiable descriptors of an aircraft system but did not yield the statistical qualities required to be considered for inclusion in an accurate cost model.

The need for identification of more reliable independent variables, that would provide statistical stability for cost estimation, was a salient issue addressed in these research studies. The structure and implementation of acquisition record keeping systems to provide the depth and accuracy of cost data for analysis was also considered an important focal point.

	A	B	C	D	
DEPENDENT VARIABLES					
Aircraft Recurring Cost				X	
Aircraft Non-recurring Cost				X	
Development Support Cost			X		
Engineering/Tooling Cost		X			
Flight Test Cost	X			X	
Manufacturing Labor Cost		X			
Manufacturing Materials Cost		X	X		
Quality Control Cost		X			
Tooling Cost			X		
Total Cost				X	
Engineering Hours					X
Manufacturing Hours					X
Quality Control Hours				X	
Tooling Hours					X
INDEPENDENT VARIABLES					
Cargo Dummy				X	
Quantity		X	X		X
Speed	X	X	X	X	
Time/Complexity	X		X		
Weight	X	X	X	X	

STUDIES

A. PRC R-547A (1967)
B. RAND R-761-PR (1972)
C. NOAH FR-103-USN (1973)
D. RAND R-1693-PA&E (1975)

Figure 2-1. Dependent/Independent Variables Developed For Aircraft Cost Estimating Models

III. DEVELOPMENT OF DATA BASE

A. REQUIREMENTS FOR BUILDING DATA BASE SYSTEM FOR T & E

1. Current Data Base

The system currently employed at NAVAIR is on three VAX-780's. This system does not facilitate either easy access to, amendment of, or rapid manipulation of the stored data due to heavy use by all branches of NAVAIR. The need for separate applications and more natural access to the data became evident in discussions with the sponsor. This need must also be filled by a system that is MS-DOS compatible that will integrate with their current on-line applications and other projected applications. The discussion in the next two sections suggests that a relational database would best fit the purpose of this study. A relational DBMS provides more timely information, better data integrity, data independence, better data management, and economies of scale. (Kroenke, 1983, p. 17)

2. Need for Data Manipulation

Constructing a data base would be greatly simplified if the only requirements were to estimate total program cost or total development and total production costs. For long-range planning studies, estimates at such aggregated levels may suffice, but they are of little use in understanding why a new program is estimated to cost a certain amount. An analyst often wants to be able to compare major cost drivers

with their counterparts to determine whether they seem reasonable and to make adjustments wherever indicated by special characteristics of the proposed aircraft (Large, 1975, p. 8), or to make design or programmatic decisions involving tradeoffs at low levels of detail. These ad hoc inquiries necessitated a tailored data base applications program that could be easily manipulated and readily interfaced into a separate statistical analysis software package such as Statsgraphic, version 2.1 or later.

3. Need for Standardization

Achieving a perfectly consistent data base when the data have been compiled by so many different contractors is extremely difficult because accounting practices differ so greatly among companies. (Large, 1975, p. 7) Thoroughly reviewing the data supplied by the contractors (levels below the required CCDR reports) and comparing them to archival data, available through NAVAIR (CCDR reports), allowed for some standardization and normalization (see Appendix A, DATA DICTIONARY). Upon completion of this step, it then becomes necessary to select an appropriate data base package for the tailored design and implementation.

B. DESIGN AND IMPLEMENTATION

Given that the data base would be used in a Local Area Network (LAN) MIS office environment, a desk top-based DBMS with advanced user interface and full transfer capabilities to the VAX-780s would be ideal. Several excellent relational data base shells are available commercially.

dBase III+ was selected for its application parameters, user friendliness and availability of technical support. The research indicated that the basic relational composition of the data base required the ability to combine aircraft specifications and test data in many different configurations as depicted in the Bachman Diagram of the logical system (Figure 3-1).

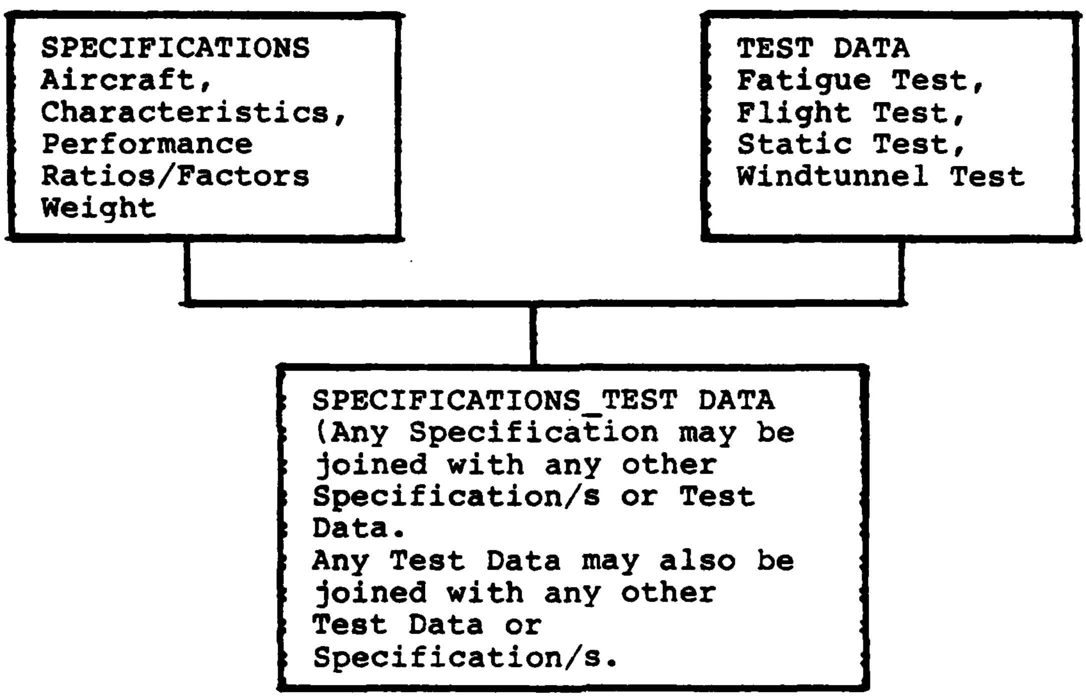


Figure 3-1. Bachman Diagram

The data was broken down at the third normal form (3NF) using the aircraft model as the key attribute. A number of predefined procedures (see Appendix B, PROGRAMS) for the manipulation of the data were compiled and a hierarchical chart was developed to enable visualization of the interrelationships of those procedures (Figure 3-2).

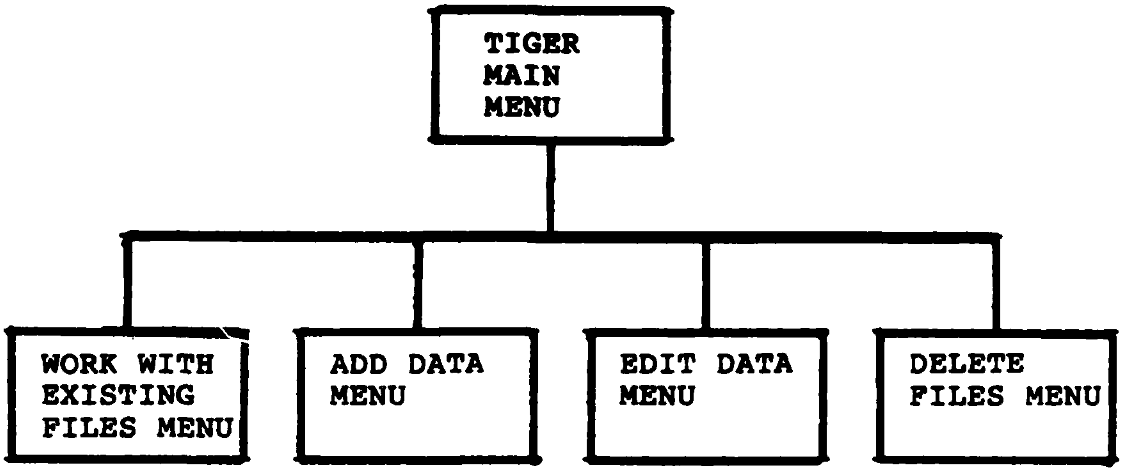


Figure 3-2. Basic Hierarchy Chart

Further decomposition led to the hierarchy depicted in Figure 3-3. The thirty-one (31) attributes and their structure (see Appendix C, DATA STRUCTURES) used in the programs evolved from this decomposition.

C. DATA BASE UTILIZATION AND BENEFITS

A User's Manual (see Appendix D, USER'S MANUAL) was developed to enhance the maintenance and portability of the applications programs. When a new aircraft is to be developed, all the available data can be inserted into the data base. Corrections to existing data as well as deletion of outdated data or entire records have also been simplified. Perhaps the major benefit of the program is its ability to merge files based on any attribute or sub-sets of attributes the analyst wishes to examine. Ad hoc queries can be processed and the analyst can review the report in a printed form (see Appendix E, REPORTS) as well as entering this newly created file into Statsgraphic, a statistical software package, to expedite the analysis process.

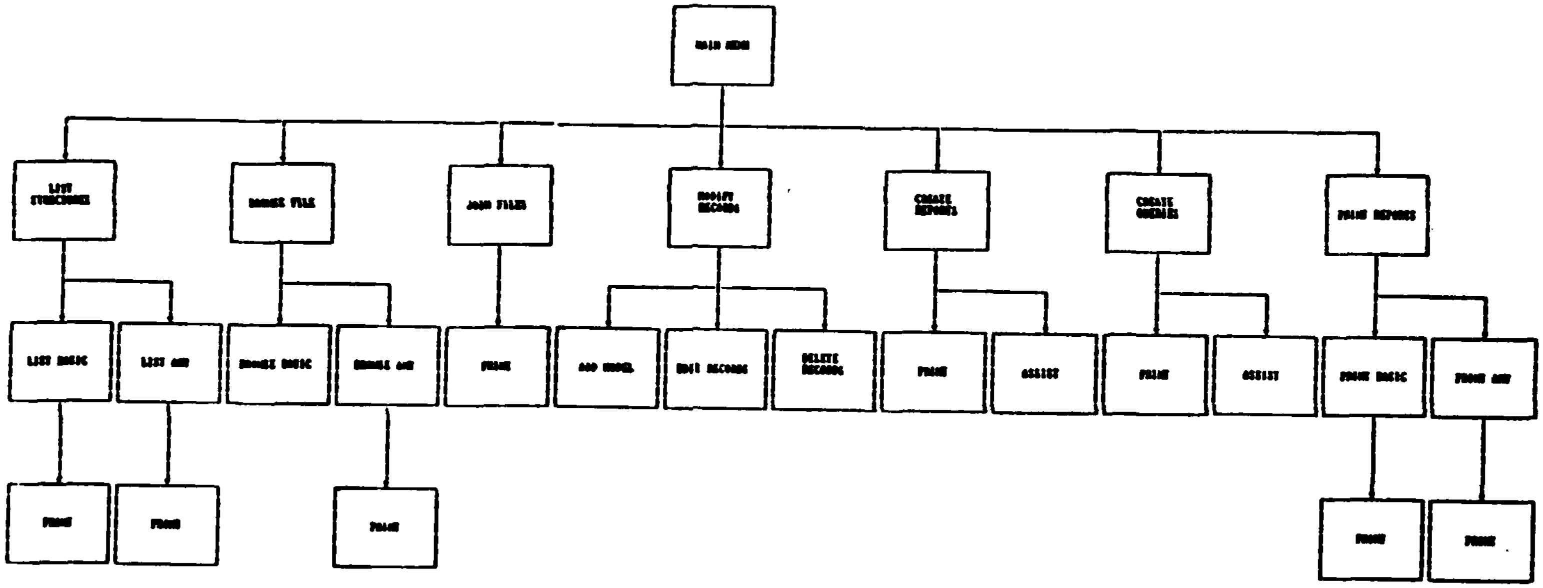


Figure 3-3. Hierarchy Chart

IV. DATA ANALYSIS OF SYSTEM TEST AND EVALUATION

A. DISCUSSION OF DATA STRUCTURES

As discussed in Chapter I, the data received were broken down into two basic categories, dependent and independent variables. These two types of variables are further described below. Appendix C (DATA STRUCTURE) lists all these variables as they are grouped into categories in the data base.

1. Dependent Variables

In the analysis process, we are trying to determine a relationship between the physical and performance characteristics of an aircraft and its test costs. The System Test and Evaluation data requested from the Defense Contractors and NAVAIR focused on direct labor hours. Direct labor hours have proven consistent in evaluating costs without regard to inflationary dollar values. Engineering, manufacturing, tooling, quality control, logistic support and total direct labor hours for the Work Breakdown Structure sub-elements of Contractor Flight Test, Static Test, Fatigue Test and Wind Tunnel Test are used as dependent variables for analysis. Standardized Work Breakdown Structure definitions of these direct labor hour cost elements as provided in Volume I, Chapter III.

2. Independent Variables

Data on aircraft physical and performance specifications are provided by Defense Contractors, NAVAIR, Aircraft Cost Handbooks (Noah, 1973; Day, 1982) and Jane's All the Worlds Aircraft reference series (1948 to present). This reference material allows an initial grouping of independent variables for estimation. The potential variables are chosen based on the availability of data, identification as proven cost drivers in previous research and expert recommendations (i.e., contractors, NAVAIR and Flight Test Centers). These specifications are separated into the following sub-categories:

a. Characteristics -
   - Number of Crew
   - Date of First Flight
   - Aircraft Wetted Area
   - Fuselage Volume
   - Wing Loading
   - Carrier Capable
   - Number of Avionics Boxes
   - Number of Engines
   - Number of Store Stations
   - Thrust

b. Ratios/Factors -
   - Limit Load Factor
   - Ultimate Load Factor
   - Empty Weight Divided by Structure Weight

Empty Weight Divided by

Aircraft Volume

Gross Takeoff Weight Divided by

Structure Weight

c. Weight - Structure Weight

Airframe Unit Weight

Empty Weight

Gross Takeoff Weight

Uninstalled Avionics Weight

Installed Avionics Weight

Maximum Structural Store Weight.

d. Performance - Maximum Speed at Optimum Alt

Maximum Speed at Sea Level

Cruise Speed

Combat Ceiling

Service Ceiling

Combat Radius

The complete data structure listing of both the dependent and independent variables are contained in Appendix C (DATA STRUCTURE).

3. Statistical Analysis Data Format

Multiple linear and non linear regression were performed. The process started by developing correlation matrices and then selecting initial independent variables with the highest correlation relating to the dependent variables and low inter-variable correlation with other

independent variables. The regression procedure fits a model relating one dependent variable to one or more independent variables by minimizing the sum of the squares of the residuals for the fitted line. Linear, multiplicative and exponential models were used. In the multiplicative and exponential models, the dependent variable is first transformed by taking its natural logarithms. Then, the model parameters are estimated. The results are then plotted using the fitted lines.

B. EVALUATION OF DATA

1. Statistical Value of the Data

The data available for analysis are given in Appendix D. During the screening process, it was determined that only Engineering hours and Total hours cost elements within the Contractor Flight Test WBS sub-category contained sufficient data points to permit statistically valid analysis. Although much of the Static Test, Fatigue Test and Wind Tunnel Test data were consistent and complete for several aircraft, there were not enough data reported in these sub-categories to lend statistical significance for the use of these cost elements as dependent variables.

The data representing both dependent and independent variables were entered into a data base to facilitate analysis and grouping of the data. The specific data points available for analysis in this study are represented in

Appendix E. Due to the proprietary nature of the data, the presence of data is represented by an 'XX' corresponding to a the applicable cost element or physical/performance characteristic.

NAVAIR supplied standardized data from historical records. This data was used to validated some of the labor hours provided by Defense Contractors. Not all of this data was able to be standardized as discussed in Chapter I. However, it was determined that this data should be included so that initial analysis could be conducted with the largest possible sample size. It is envisioned that NAVAIR will continue further collection and standardization of this data so that more definitive statistical analysis can be accomplished as data becomes available.

C. ANALYSIS OF COST DRIVERS

As independent variables were initially evaluated for consideration as cost drivers, a one-sample analysis was performed to indicate data consistency (Statgraphics, 1986 p. 11-2). A histogram plot of variables with greater than ten data points was developed. This enabled an analysis of both data groupings and variable comparison of physical/ performance characteristics. The resulting one-sample analysis and histograms are contained in Appendix F.

All of the independent variables were considered for potential analysis. Several were evaluated as not having

sufficient data points required for successful multiple regression techniques. The following cost drivers were considered to have the most significant impact for cost estimation modeling: Number of Crew (CREW), Date of First Flight (FF), Wing Loading (WL), Carrier Qualified(CQ), Number of Engines (ENG), Thrust, Empty Weight Divided by Structure Weight (WEOWS or WE/WS), Gross Takeoff Weight Divided by Structure Weight (GTOWOWS or GTOW/WS), Structure Weight (WS), Empty Weight (WE), Gross Takeoff Weight (GTOW), Uninstalled Avionics Weight (WAVU), Installed Avionics Weight (WAVI), Maximum Speed at Optimum Altitude (VMAXA), Maximum Speed at Sea Level (VMAXS), Cruise Speed (VCRUISE), Combat Ceiling (CBCEIL), Service Ceiling (SERCEIL) and combinations of the above.

D. DEVELOPMENT OF COST DRIVER MODELS

Both stepwise least-squares procedures and single step multiple regression techniques were used to determine the best cost driver models. All of the potential independent variables were tested with respect to dependent variables of Contractor Flight Test Engineering and Total direct labor hours. During the initial regression, a F-ratio of 4.0 was used as a threshold for inclusion of independent variables in the equation. Past historical studies showed that certain particular variables were not determined to influences the cost (Rand, 1975, p.16). However, we

eliminated the independent variables based solely on their statistical insignificance. The multiple-regression package used calculates the usual statistical measures of fit and provides plots of the fit. This package eliminates observations with missing data points thereby decreasing the sample size for analysis. These results are shown with the development of each equation in APPENDIX G. In selecting preferred equations, a high coefficient of determination (R^2), the F statistic for tests concerning the equality of the independent variables standard deviations, and the independent T values are the basis for variables initially being included in the regression. Both linear and logarithmic regression were used. Although logarithmic regression minimizes relative errors, some extremely valuable linear equations were found which had as good if not better statistical significance.

1. Contractor Flight Test Total Labor Hours

a. Weight and Speed Variables

The independent variables initially used with the Total Hours cost element were selected from the outcomes of previous studies and expert opinion, in this area, focusing on aircraft weight and speed. All variables of weight and speed, including ratios of both, were evaluated as potential cost drivers. It was found that the non-availability of complete data created a wide variation in the outcomes of the analysis. With a large sample size, the

statistical significance of the equation was less than that of one with a small sample size.

Utilizing only two independent variables--weight and speed--the following log-linear equation resulted:

EQUATION 1 (Refer to pp. 184, 185)

$$\text{TOTALHRS} = -1.64\ (\text{VMAXA})^{1.67}\ (\text{WEOWS})^{-2.89}$$

R2 = .59

F-Ratio = 11.56

19 Observations

Utilizing stepwise regression, including all the weight, speed and weight ratio variables, the most conclusive relationship developed, resulting in the following log-linear equation and relating statistics:

EQUATION 2 (Refer to pp. 186, 187)

$$\text{TOTALHRS} = -10.89\ (\text{WS})^{.99}\ (\text{VMAXS})^{1.47}$$

R2 = .95

F-Ratio = 69

10 Observations including: A-10, A-4, A-5, A-6, F-14, F-15, F-4, F/A-18, S-3, T-38

Both of these relationships are statistically sound. What also must be considered is the observation size which was reduced by the inclusion of other independent variables with less data availability.

b. **Consideration of Other Variables**

As the other potential cost drivers were also considered, several variables emerged as being consistently reliable. These included characteristics, performance and avionics weight factors. Interestingly, avionics weight emerged as particularly significant independent variable when used as a percentage factor of either Aircraft Structure Weight (WS) or Empty Weight (WE). This component provided a sizing factor for avionics that provided an easy comparison across all types of aircraft. The integration of avionics accounts for a large number of direct labor hours in the Contractor Flight Test effort. This allows for consideration of avionics as an important cost driver. In the past, avionics was overlooked. It was only considered as a portion of total airframe weight.

With these variables considered, the analysis yielded the following estimated equation:

EQUATION 3 (Refer to pp. 196, 197)

TOTALHRS = -6726.84 + 2.33 (VMAXA) + 35.22 (WL)

+ 97.29 (WE/WAVI) + .13 (WE)

R^2 = .95

F-Ratio = 36.4

12 Observations

As more physical and performance characteristics were introduced, the sample size evaluated through stepwise multiple regression decreased again due to missing data

points. This small sample size consisted of a more homogeneous grouping of aircraft by type and weight (<100,000 lbs.). The evaluation of this sample grouping with more independent variables yielded a statistically significant result. The following was obtained from the analysis:

EQUATION 4 (Refer to pp. 220, 221)

$$TOTALHRS = 6.87\,(VMAXA)^{.70}(WS/WAVI)^{18.75}(WAVU)^{2.43}(GTOW)^{-17.03}(GTOW/WS)^{17.13}$$

$R2 = .98$

F-Ratio = 62.1

11 Observations

EQUATION 5 (Refer to pp. 222, 223)

$$TOTALHRS = -\,6.32\,(VMAXA)^{.82}(WS/WAVI)^{1.12}$$

$R2 = .92$

F-Ratio = 57.1

13 Observations

EQUATION 6 (Refer to pp. 224, 225)

$$TOTALHRS = -6765.36 + 2.34\,(VMAXA) + 30.94\,(WL) + 101.32\,(WS/WAVI) + 0.15\,(WE)$$

$R2 = .95$

F-Ratio = 41.5

13 Observations

2. Contractor Flight Test Engineering Hours

a. Weight and Speed Variables

The independent variables used with the Engineering direct labor hours cost element were selected with the same criteria and constraints as in Total Hours.

Utilizing only two independent variables--weight and speed--the following log-linear equation were derived:

EQUATION 7 (Refer to pp. 230, 231)

$$ENGHRS = 0.23\ (VMAXA)^{1.29}\ (WEOWS)^{-2.67}$$

$R2 = .48$

F-Ratio = 6.8

18 Observations

Utilizing stepwise regression, including all the weight, speed and weight ratio variables, the most conclusive relationship emerged, resulting in the following linear equations and related statistics:

EQUATION 8 (Refer to pp. 232, 233)

$$ENGHRS = -664.71 + 0.23\ (WS) + 1.73\ (VMAXA) - 0.04\ (GTOW)$$

$R2 = .91$

F-Ratio = 25.02

11 Observations including: A-10, A-4, A-5, A-6, AV-8B, F-14, F-15, F-4, F/A-18, S-3, T-38.

Both of these relationships are statistically valid with the considerations as mentioned with Total Hours.

b. Consideration of Other Variables

The same independent variables used in Total Hours were evaluated. With these variables considered, the following relationship of cost drivers yielded the following results:

EQUATION 9 (Refer to pp. 236, 237)

$$ENGHRS = 165.13 + 3.21\ (VMAXA) + 67.20\ (FF) - 2143.66\ (THRUST/WE)$$

R2 = .71

F-Ratio = 10.6

17 Observations

A smaller sample size of aircraft with Gross Takeoff Weight less than 100,000 lbs. resulted in the following analysis:

EQUATION 10 (Refer to pp. 242, 243)

$$ENGHRS = -\ 574.34 + 0.72\ (VMAXA) + 7.85\ (WL) + 29.2\ (WS/WAVI) + 0.37\ (WAVU) + 0.22\ (WE) - 0.07\ (GTOW) - 18.22\ (FF) - 706.75\ (CREW)$$

R2 = .998

F-Ratio = 170.17

11 Observations including: A-10, A-4, A-5, A-6, AV-8B, F-14, F-15, F-4, F/A-18, S-3, T-38.

EQUATION 11 (Refer to pp. 244, 245)

$$ENGHRS = 1.1\ (VMAXA)^{.89}(WS/WAVI)^{2.24}(GTOW)^{-1.52}$$

R2 = .79

F-Ratio = 12.7

14 Observations

E. SUMMARY

Contractor Flight Test Total direct labor hours proved to be a more stable dependent variable than Engineering direct labor hours. The best cost drivers were determined using a sample size with Gross Takeoff Weight restricted to less than 100,000 lbs. In most relationships, the avionics weight percentage factor emerged as particularly significant independent variable.

No best cost model can be recommended at this point due to lack of data causing variance in observation size between cost estimating relationships.

V. SUMMARY

The purpose of this research was to review the current cost estimating structure in Aircraft Systems Test and Evaluation and provide better cost estimation models, with particular emphasis on Contractor Flight Test elements.

A. SUMMARY OF RESULTS

As a result of extensive field investigation, data collection, database design and implementation and parametric modeling, the major findings of this research are enumerated below:

1. Propositions for a better implementation of the CCDR

The Contractor cost Data Reporting (CCDR) system was established to provide the DOD with continual ability to develop and use valid cost estimates (Chapter II, Volume I). However, from a cost estimation standpoint, current practices of the CCDR system suffer from numerous shortcomings. First, CCDR reports have often been inconsistent across contractors due to ambiguity in defining cost elements. Second, dual source and sub-contracts are more than frequently granted. Contractors habitually cannot, or do not want to cooperate with other contractors. Third, cost data have not been reported regularly enough for time-series analysis.

This research proposed a number of courses of action that could at least correct some of these shortcomings for more meaningful and accurate data analysis: (1) factor the Work Breakdown Structure (WBS) into lower levels, (2) provide time-phased data reporting, and (3) implement a well-defined CCDR data base system (Chapter III, Volume I). Furthermore, this study suggested an eventual restructurization of the WBS by revising the hierarchy of the WBS elements.

2. Elicitation of experts' opinion to identify the most important cost-drivers in System Test and Evaluation

Past scientific studies have primarily considered weight, speed and the number of aircraft as the most statistically significant cost estimators. Due to technological innovations, other cost drivers have recently emerged. This study conducted a nation-wide field investigation. The following factors were identified as essential cost drivers: mission, aircraft weight, aircraft speed, avionics complexity, software, power supplies, data reduction, number of test aircraft, delivery schedule, joint contractor/ military testing and political environment (Chapter V, Volume I).

The interviews with defense contractors and military test centers also resulted in numerous recommendations for improvement of the current process of System Test and Evaluation. Among these, the following strategies have triggered substantial interest: (1) use of simulation in

software testing, (2) use of structured analysis and design methodology to develop software, (3) implementation of distributed systems using parallel process, (4) development of more efficient power units to reduce weight and volume of avionics of aircraft, (5) reduction of the required number of test aircraft, and (6) delivery of aircraft in a block (phase program). In addition, in a longer perspective, further studies are necessary to determine if joint testing is producing the highest quality and most cost-efficient aircraft.

3. Survey of Current Data and Structure Maintained by Defense Contractors and Military Institutions

As an effort to gather data for cost modeling, this research gathered data from defense contractors and military test centers. Data were provided by Boeing, Rockwell International at Columbus, Fairchild, Grumman Aerospace Corporation, Rockwell International at Los Angeles, LTV Aerospace and Defense, General Dynamics, McDonnell Douglas, Lockheed Georgia, Lockheed California, the Naval Air Test Center, the Air Force Test Flight Center, and NAVAIR. It was found that some data were better and more complete than others. It was also found that some data requested could not be obtained (Chapter I, Volume II).

4. Survey of Parametric Techniques for Estimating Cost of Aircraft Systems

Avionics and software costs have emerged as growing elements in the acquisition of new aircraft systems.

Despite the difference in samples and statistical approaches each study used for estimation, the two primary aircraft characteristics or variables/drivers for airframe cost remained weight and speed.

The need for identification of more reliable independent variables, that would provide statistical stability for cost estimation, was a salient issue addressed in these econometric estimations. The structure and implementation of acquisition record keeping systems to provide the depth and accuracy of cost data for analysis were also considered an important focal point.

5. Development of a Cost Estimation Relational Data Base System

The current NAVAIR system does not facilitate either easy access to, amendment of, or rapid manipulation of the stored data for cost estimation due to heavy use by all branches of NAVAIR. The need for separate applications and more natural access to the data became evident in discussions with the sponsor. This need must also be filled by a system that is MS-DOS compatible and will integrate with current on-line applications and other projected applications.

Given that the data base would be used in a Local Area Network (LAN) MIS office environment, a desk top-based DBMS with advanced user interface and full transfer capabilities to the VAX-780s would be ideal was implemented using dBase III Plus (Chapter III, Volume II).

6. <u>Development of New Parametric Cost Estimation Models</u>

Contractor Flight Test Total direct labor hours proved to be a more stable dependent variable than Engineering direct labor hours. The best cost drivers were determined using a sample size with Gross Takeoff Weight restricted to less than 100,000 lbs. In most relationships, the avionics weight percentage factor emerged as a particularly significant independent variable (Chapter IV, Volume II).

B. SUGGESTIONS FOR FUTURE RESEARCH

The conclusions developed through the statistical analysis are extensions and improvements on the previous studies cited. As more data are collected, standardized and inputted the equations developed should increase in accuracy. The rapidly changing "state of the art" in avionics and its commensurate effects on cost estimation and analysis of aircraft systems that have been previously identified, continues to be of concern. This effect on cost estimation will not be solved until a method of collection of engineering and total hours in the WBS and CCDR is adopted at lower levels than previously used. This paucity of data hampered this research and undoubtably will hamper future research and consequently the accuracy of estimation on proposed aircraft. The groundwork had been laid, this takes that groundwork but one step further. It is hoped

that this thesis will be of value to both the public and private sectors. The challenge to future research lies in the adoption of measures to insure clarity across both contractor and government lines. Then, precision and accuracy can be insured.

APPENDIX A: DATA DICTIONARY

AIRCRAFT	=	MODEL + MISSION + MFG
AVBX	=	Number of avionics boxes in aircraft system
AWA	=	Aircraft wetted area
CBT_CEIL	=	Maximum rated combat ceiling
CBT_RADIUS	=	Radius of operation for combat purposes in miles
CHAR	=	MODEL + CREW + FIRST_FLT + AWA + VOL + WL + CQ + AVBX + ENG + SSTA + THRUST
CREW	=	Number of crew members
CQ	=	Is the aircraft carrier qualified
ENG	=	Number of engines
ENGHR	=	Number of engineering hours spent on flight testing
FATIGUE	=	MODEL + FTMOS + FTHRS + FENGHRS + FMFGHRS + FTOOLHR + FQCHRS + FILSHRS + FTOTHRS
FENGHRS	=	Number of engineering hours spent on fatigue testing
FILSHRS	=	Number of integrated logistic support hours spent on fatigue testing
FIRST_FLT	=	Date of first flight since 1952
FLIGHT	=	MODEL + FLTHRS + TEVTS + ENGHR + MFGHR + TOOLHR + QCHR + ILSHR + TOTHRS
FLTHRS	=	Number of hours the aircraft spent in actual flight testing
FMFGHRS	=	Number of manufacturing hours spent on fatigue testing
FQCHRS	=	Number of quality control hours spent on fatigue testing
FTHRS	=	Number of hours the aircraft spent in actual fatigue testing

FTMOS	=	Number of months the aircraft underwent fatigue testing
FTOOLHR	=	Number of tooling hours spent on fatigue testing
FTOTHRS	=	Total number of hours spent on fatigue testing
GTOW	=	Gross takeoff weight
GTOW/WS	=	Gross takeoff weight/Structure weight
ILSHR	=	Number of integrated logistic support hours spent on flight testing
LLF	=	Load limit factor
MAXWSS	=	Maximum structure stores weight
MFG	=	Manufacturer's Name
MFGHR	=	Number of manufacturing hours spent on flight testing
MISSION	=	[ASW | Attack | Bomber | Early War | EW Fighter | Patrol | Recon | Trainer | Transport]
MODEL	=	Aircraft's model number
PERFORMA	=	MODEL + THRUST + VMAXA + VMAXS + VCRUISE + CBT_CEIL + SER_CEIL + CBT_RADIUS
QCHR	=	Number of quality control hours spent on flight testing
SENGHRS	=	Number of engineering hours spent on static testing
SER_CEIL	=	Maximum rated ceiling
SILSHRS	=	Number of integrated logistic support hours spent on static testing
SMFGHRS	=	Number of manufacturing hours spent on static testing
SQCHRS	=	Number of quality control hours spent on static testing

SSTA	=	Number of aircraft store stations
STATIC	=	MODEL + STMOS + SENGHRS + SMFGHRS + STOOLHR + SQCHRS + SILSHRS + STOTHRS
STMOS	=	Number of months the aircraft underwent static testing
STOOLHR	=	Number of tooling hours spent on static testing
STOTHRS	=	Total number of hours spent on static testing
TEVTS	=	Number of separate specific tests performed during the flight testing
THRUST	=	[Pounds of Thrust | Shaft Horsepower | Horsepower]
TOOLHR	=	Number of tooling hours spent on flight testing
TOTHRS	=	Total number of hours spent on flight testing
ULF	=	Unlimited load factor
VCRUISE	=	Normal cruising speed in knots
VMAXA	=	Maximum speed at optimum altitude
VMAXS	=	Maximum speed at sea level
VOL	=	Fuselage volume
WA	=	Aircraft unit weight
WAVI	=	Installed avionics weight
WAVU	=	Uninstalled avionics weight
WE	=	Empty weight of the aircraft
WE/VOL	=	Empty weight/Volume
WE/WS	=	Empty weight /Structure weight
WEIGHT	=	MODEL + WS + WA + WE + GTOW + WAVU + WAVI + MAXWSS

WENGHRS	=	Number of engineering hours spent on wind tunnel testing
WILSHRS	=	Number of integrated logistic support hours spent on wind tunnel testing
WIND	=	MODEL + WTMOS + WTHRS + WENGHRS + WMFGHRS + WTOOLHR + WQCHRS + WILSHRS + WTOTHRS
WL	=	Wing strength measured in pounds per square foot
WMFGHRS	=	Number of manufacturing hours spent on wind tunnel testing
WQCHRS	=	Number of quality control hours spent on wind tunnel testing
WS	=	Structure weight
WTHRS	=	Number of hours the aircraft spent in actual wind tunnel testing
WTMOS	=	Number of months the aircraft underwent wind tunnel testing
WTOOLHR	=	Number of tooling hours spent on wind tunnel testing
WTOTHRS	=	Total number of hours spent on wind tunnel testing

APPENDIX B: PROGRAMS

```
* Program..: ADDMOD.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to add models to the basic files.
* Date.....: 12/05/86
* I/O Files: AIRCRAFT.DBF, CHAR.DBF, FATIGUE.DBF, FLIGHT.DBF,
*            PERFORMA.DBF, RATIOS.DBF, STATIC.DBF,
*            WEIGHT.DBF, WIND.DBF
* Called By: TIGER.PRG, MODMENU.PRG
* Calls Mod: NONE
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading

   CLEAR
         USE ADDFILE
         APPEND
         CLEAR

@ 12,22 SAY [ADDING MODELS TO ALL BASIC FILES.....]

         USE AIRCRAFT
         APPEND FROM ADDFILE
         SORT ON MODEL TO TEMPSORT.DBF
         CLOSE ALL
         ERASE AIRCRAFT.DBF
         RENAME TEMPSORT.DBF TO AIRCRAFT.DBF

         USE CHAR
         APPEND FROM ADDFILE
         SORT ON MODEL TO TEMPSORT.DBF
         CLOSE ALL
         ERASE CHAR.DBF
         RENAME TEMPSORT.DBF TO CHAR.DBF

         USE PERFORMA
         APPEND FROM ADDFILE
         SORT ON MODEL TO TEMPSORT.DBF
         CLOSE ALL
         ERASE PERFORMA.DBF
         RENAME TEMPSORT.DBF TO PERFORMA.DBF
```

```
          USE WEIGHT
          APPEND FROM ADDFILE
          SORT ON MODEL TO TEMPSORT.DBF
          CLOSE ALL
          ERASE WEIGHT.DBF
          RENAME TEMPSORT.DBF TO WEIGHT.DBF

          USE RATIOS
          APPEND FROM ADDFILE
          SORT ON MODEL TO TEMPSORT.DBF
          CLOSE ALL
          ERASE RATIOS.DBF
          RENAME TEMPSORT.DBF TO RATIOS.DBF

          USE FATIGUE
          APPEND FROM ADDFILE
          SORT ON MODEL TO TEMPSORT.DBF
          CLOSE ALL
          ERASE FATIGUE.DBF
          RENAME TEMPSORT.DBF TO FATIGUE.DBF

          USE FLIGHT
          APPEND FROM ADDFILE
          SORT ON MODEL TO TEMPSORT.DBF
          CLOSE ALL
          ERASE FLIGHT.DBF
          RENAME TEMPSORT.DBF TO FLIGHT.DBF

          USE STATIC
          APPEND FROM ADDFILE
          SORT ON MODEL TO TEMPSORT.DBF
          CLOSE ALL
          ERASE STATIC.DBF
          RENAME TEMPSORT.DBF TO STATIC.DBF

          USE WIND
          APPEND FROM ADDFILE
          SORT ON MODEL TO TEMPSORT.DBF
          CLOSE ALL
          ERASE WIND.DBF
          RENAME TEMPSORT.DBF TO WIND.DBF

*         SET CONFIRM OFF
*         STORE ' ' TO wait_subst
*         @ 23,0 SAY 'Press any key to continue...' GET wait_subst

*         READ
*         SET CONFIRM ON
          CLEAR
          USE ADDFILE
          ZAP
RETURN
* EOF: ADDMOD.PRG
^Z
```

```
* Program..: BROANY.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows the user to browse any current database file
* Date.....: 01/01/80
* I/O Files: Any database file selected by user.
* Called By: TIGER.PRG, BROWMENU.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading

   CLEAR
   @ 2, 0 TO 12,79 DOUBLE
   @ 3,15 SAY [B R O W S E  C U R R E N T  F I L E S  M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. BROWSE ANY FILE]
   @  8,31 SAY [2. LIST FILES]
   @ 10, 31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select    "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2

  READ

  DO CASE

     CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

     CASE selectnum = 1
      *   DO BROWSE ANY FILE
         ACCEPT [Enter filename....] to BROFILE
         USE &BROFILE
         GO TOP
         BROWSE
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON
```

```
    CASE selectnum = 2
     *  DO LIST FILES
        DO PRINT
        DIR *.DBF
        SET PRINT OFF
        SET CONFIRM OFF
        STORE ' ' TO wait_subst
        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
        READ
        SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: BROANY.PRG

^Z
```

```
* Program..: BROBASIC.PRG
* Author...: TUNG'S TIGERS
* Purpose..: This option allows the user to browse the basic data
*            files.
* Date.....: 12/06/86
* I/O Files: AIRCRAFT.DBF, CHAR.DBF, FATIGUE.DBF, FLIGHT.DBF,
*            PERFORMA.DBF, RATIOS.DBF, STATIC.DBF,
*            WEIGHT.DBF, WIND.DBF
* Called By: TIGER.PRG, BROWMENU.PRG
* Calls Mod: NONE
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading

   CLEAR
   @ 2, 0 TO 19,79 DOUBLE
   @ 3,18 SAY [B R O W S E   B A S I C   F I L E S   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. AIRCRAFT]
   @  8,31 SAY [2. CHARACTERISTICS]
   @  9,31 SAY [3. PERFORMANCE]
   @ 10,31 SAY [4. RATIOS/FACTORS]
   @ 11,31 SAY [5. WEIGHT]
   @ 12,31 SAY [6. FATIGUE TEST]
   @ 13,31 SAY [7. FLIGHT TEST]
   @ 14,31 SAY [8. STATIC TEST]
   @ 15,31 SAY [9. WIND TUNNEL TEST]
   @ 17, 31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 19,33 SAY " select    "
   @ 19,42 GET selectnum PICTURE "9" RANGE 0,9

   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN
```

```
CASE selectnum = 1
*   DO AIRCRAFT
    USE AIRCRAFT
     GO TOP
     BROWSE
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

CASE selectnum = 2
*   DO CHARACTERISTICS
    USE CHAR
    GO TOP
    BROWSE
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

CASE selectnum = 3
*   DO PERFORMANCE
    USE PERFORMA
    GO TOP
    BROWSE
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

CASE selectnum = 4
*   DO RATIOS/FACTORS
    USE RATIOS
    GO TOP
    BROWSE
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

CASE selectnum = 5
*   DO WEIGHT
    USE WEIGHT
    GO TOP
    BROWSE
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON
```

```
      CASE selectnum = 6
      *  DO FATIGUE TEST
         USE FATIGUE
         GO TOP
         BROWSE
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

      CASE selectnum = 7
      *  DO FLIGHT TEST
         USE FLIGHT
         GO TOP
         BROWSE
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

      CASE selectnum = 8
      *  DO STATIC TEST
         USE STATIC
         GO TOP
         BROWSE
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

     CASE selectnum = 9
      *  DO WIND TUNNEL TEST
         USE WIND
         GO TOP
         BROWSE
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: BROBASIC.PRG

^Z
```

```
* Program..: BROWMENU.PRG
* Author...:  TUNG'S TIGERS
* Purpose..: This option allows the user to select the browse
*            option he wants
* Date.....: 01/01/80
* I/O Files: NONE
* Called By: TIGER.PRG
* Calls Mod: BROBASIC.PRG, BROANY.PRG
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR

   @ 2, 0 TO 12,79 DOUBLE
   @ 3,24 SAY [B R O W S E   F I L E S   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,29 SAY [1. BROWSE BASIC FILES]
   @  8,29 SAY [2. BROWSE ANY FILES]
   @ 10, 29 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select    "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2

   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO BROWSE BASIC FILES
         DO BROBASIC
*        SET CONFIRM ON
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM OFF
```

```
        CASE selectnum = 2
        *  DO BROWSE ANY FILES
           DO BROANY
*          SET CONFIRM OFF
*          STORE ' ' TO wait_subst
*          @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*          READ
*          SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: BROWMENU.PRG

^Z
```

```
* Program..: CQUERYMENU.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to create ad hoc queries.
* Date.....: 12/06/86
* I/O Files: ANY SELECTED BY USER
* Called By: TIGER.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR

   @ 2, 0 TO 12,79 DOUBLE
   @ 3,24 SAY [C R E A T E   Q U E R Y   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. CREATE NEW QUERY]
   @  8,31 SAY [2. LIST QUERY FILES]
   @ 10, 31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select     "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2

   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO CREATE NEW QUERY
         CREATE QUERY
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*         READ
*         SET CONFIRM ON
```

```
      CASE selectnum = 2
      *  DO LIST QUERY FILES
         DO PRINT
         DIR *.QRY
         SET PRINT OFF
         SET CONFIRM OFF
         STORE ' ' TO wait_subst
         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
         READ
         SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: CQUERYMENU.PRG

^Z
```

```
* Program..: CREPORTMENU.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to create ad hoc reports.
* Date.....: 12/06/86
* I/O Files: ANY SELECTED BY USER
* Called By: TIGER.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR

   @ 2, 0 TO 12,79 DOUBLE
   @ 3,23 SAY [C R E A T E   R E P O R T   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,26 SAY [1. CREATE NEW REPORT]
   @  8,26 SAY [2. LIST EXISTING REPORT FILES]
   @ 10, 26 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select     "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2
   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO CREATE NEW REPORT
         CREATE REPORT
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET Wait_subst
*        READ
*        SET CONFIRM ON
```

```
    CASE selectnum = 2
    *  DO LIST EXISTING REPORT FILES
       DO PRINT
       DIR *.FRM
       SET PRINT OFF
       SET CONFIRM OFF
       STORE ' ' TO wait_subst
       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
       READ
       SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: CREPORTMENU.PRG

^Z
```

```
* Program..: DELREC.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to delete records from nine basic files.
* Date.....: 12/05/86
* I/O Files: The nine basic files.
* Called By: TIGER.PRG, MODREC.PRG
* Calls Mod: NONE
* Reserved.: selectnum
* Variables: DEMODEL, WAITPACK

SET TALK OFF
SET BELL ON
SET STATUS ON
SET ESCAPE ON
SET CONFIRM ON

DO WHILE .T.
SET COLOR TO W+/R+,GR+/B+,R+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading

   CLEAR

        STORE " " TO DELETEMODEL
        ACCEPT "ENTER AIRCRAFT MODEL ..." TO DELETEMODEL

        USE AIRCRAFT
        DELETE FOR MODEL=DELETEMODEL
        STORE " " TO WAITPACK
        SET COLOR TO GR+/R+
        WAIT [DELETE MARKED AIRCRAFT RECORDS? (Y/N)] TO WAITPACK
        IF UPPER(WAITPACK)="Y"
              PACK
        ELSE RECALL ALL
        ENDIF

        USE CHAR
        DELETE FOR MODEL=DELETEMODEL
        STORE " " TO WAITPACK
        WAIT [DELETE MARKED CHARACTER RECORDS? (Y/N)] TO WAITPACK
        IF UPPER(WAITPACK)="Y"
              PACK
        ELSE RECALL ALL
        ENDIF

        USE PERFORMA
        DELETE FOR MODEL=DELETEMODEL
        STORE " " TO WAITPACK
        WAIT [DELETE MARKED PERFORMANCE RECORDS? (Y/N)] TO
       WAITPACK
        IF UPPER(WAITPACK)="Y"
              PACK
        ELSE RECALL ALL
        ENDIF
```

```
USE RATIOS
DELETE FOR MODEL=DELETEMODEL
STORE " " TO WAITPACK
WAIT [DELETE MARKED RATIOS RECORDS? (Y/N)] TO WAITPACK
IF UPPER(WAITPACK)="Y"
      PACK
ELSE RECALL ALL
ENDIF

USE WEIGHT
DELETE FOR MODEL=DELETEMODEL
STORE " " TO WAITPACK
WAIT [DELETE MARKED WEIGHT RECORDS? (Y/N)] TO WAITPACK
IF UPPER(WAITPACK)="Y"
      PACK
ELSE RECALL ALL
ENDIF

USE FATIGUE
DELETE FOR MODEL=DELETEMODEL
STORE " " TO WAITPACK
WAIT [DELETE MARKED FATIGUE RECORDS? (Y/N)] TO WAITPACK
IF UPPER(WAITPACK)="Y"
      PACK
ELSE RECALL ALL
ENDIF

USE FLIGHT
DELETE FOR MODEL=DELETEMODEL
STORE " " TO WAITPACK
WAIT [DELETE MARKED FLIGHT RECORDS? (Y/N)] TO WAITPACK
IF UPPER(WAITPACK)="Y"
      PACK
ELSE RECALL ALL
ENDIF

USE STATIC
DELETE FOR MODEL=DELETEMODEL
STORE " " TO WAITPACK
WAIT [DELETE MARKED STATIC RECORDS? (Y/N)] TO WAITPACK
IF UPPER(WAITPACK)="Y"
      PACK
ELSE RECALL ALL
ENDIF

USE WIND
DELETE FOR MODEL=DELETEMODEL
STORE " " TO WAITPACK
WAIT [DELETE MARKED WIND RECORDS? (Y/N)] TO WAITPACK
IF UPPER(WAITPACK)="Y"
      PACK
ELSE RECALL ALL
ENDIF
```

```
*          SET CONFIRM OFF
*          STORE ' ' TO wait_subst
*          @ 23,0 SAY "Press any key to continue..." GET wait_subst
*          READ
*          SET CONFIRM ON

CLEAR

RETURN

ENDDO T

* EOF: DELREC.PRG

^Z
```

```
* Program..: DELRMENU.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Caution user concerning permanently deleting records
* Date.....: 02/20/87
* I/O Files: NONE
* Called By: TIGER.PRG, MODMENU.PRG
* Calls Mod: DELREC.PRG
* Reserved.: selectnum

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+,GR+/R+,R+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 11,79 DOUBLE
   @ 3,27 SAY [D E L E T E   R E C O R D S]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7, 7 SAY [1. YOU ARE ABOUT TO PERMANENTLY DELETE SELECTED]
   @  7, 55 SAY [RECORDS FROM FILES]
   @  9,  7 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 11,33 SAY " select     "
   @ 11,42 GET selectnum PICTURE "9" RANGE 0,1
   READ

   DO CASE
      CASE selectnum = 0
         SET BELL ON
         SET TALK ON
         CLEAR ALL
         SET COLOR TO GR+/B+,GR+/R+,BG+
         RETURN

      CASE selectnum = 1
      *   DO YOU ARE ABOUT TO PERMANENTLY DELETE SELECTED RECORDS
      *  FROM FILES
         DO DELREC
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

ENDCASE
ENDDO T
SET COLOR TO GR+/B+,GR+/R+,BG+
RETURN
* EOF: DELRMENU.PRG

^Z
```

```
* Program..: EDITREC.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to edit the nine basic files.
* Date.....: 12/05/86
* I/O Files: AIRCRAFT.DBF, CHAR.DBF, FATIGUE.DBF, FLIGHT.DBF,
*            PERFORMA.DBF, RATIOS.DBF, STATIC.DBF, WEIGHT.DBF,
*            WIND.DBF
* Called By: TIGER.PRG, MODMENU.PRG
* Calls Mod: NONE
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading

   CLEAR
   @ 2, 0 TO 19,79 DOUBLE
   @ 3,25 SAY [E D I T   R E C O R D S   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. AIRCRAFT]
   @  8,31 SAY [2. CHARACTERISTICS]
   @  9,31 SAY [3. PERFORMANCE]
   @ 10,31 SAY [4. RATIOS/FACTORS]
   @ 11,31 SAY [5. WEIGHT]
   @ 12,31 SAY [6. FATIGUE TEST]
   @ 13,31 SAY [7. FLIGHT TEST]
   @ 14,31 SAY [8. STATIC TEST]
   @ 15,31 SAY [9. WIND TUNNEL TEST]
   @ 17, 31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 19,33 SAY " select     "
   @ 19,42 GET selectnum PICTURE "9" RANGE 0,9
   READ

   DO CASE

      CASE selectnum = 0
         SET TALK OFF
         CLEAR ALL
         RETURN
```

```
CASE selectnum = 1
*   DO AIRCRAFT
    USE AIRCRAFT
    EDIT
*   SET CONFIRM OFF
*   STORE ' ' TO wait_subst
*   @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*   READ
*   SET CONFIRM ON

CASE selectnum = 2
*   DO CHARACTERISTICS
    USE CHAR
    EDIT
*   SET CONFIRM OFF
*   STORE ' ' TO wait_subst
*   @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*   READ
*   SET CONFIRM ON

CASE selectnum = 3
*   DO PERFORMANCE
    USE PERFORMA
    EDIT
*   SET CONFIRM OFF
*   STORE ' ' TO wait_subst
*   @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*   READ
*   SET CONFIRM ON

CASE selectnum = 4
*   DO RATIOS/FACTORS
    USE RATIOS
    EDIT
*   SET CONFIRM OFF
*   STORE ' ' TO wait_subst
*   @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*   READ
*   SET CONFIRM ON

CASE selectnum = 5
*   DO WEIGHT
    USE WEIGHT
    EDIT
*   SET CONFIRM OFF
*   STORE ' ' TO wait_subst
*   @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*   READ
*   SET CONFIRM ON
```

```
        CASE selectnum = 6
        *  DO FATIGUE TEST
           USE FATIGUE
           EDIT
*          SET CONFIRM OFF
*          STORE ' ' TO wait_subst
*          @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*          READ
*          SET CONFIRM ON

        CASE selectnum = 7
        *  DO FLIGHT TEST
           USE FLIGHT
           EDIT
*          SET CONFIRM OFF
*          STORE ' ' TO wait_subst
*          @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*          READ
*          SET CONFIRM ON

        CASE selectnum = 8
        *  DO STATIC TEST
           USE STATIC
           EDIT
*          SET CONFIRM OFF
*          STORE ' ' TO wait_subst
*          @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*          READ
*          SET CONFIRM ON

        CASE selectnum = 9
        *  DO WIND TUNNEL TEST
           USE WIND
           EDIT
*          SET CONFIRM OFF
*          STORE ' ' TO wait_subst
*          @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*          READ
*          SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: EDITREC.PRG

^Z
```

```
* Program..: JOINFILE.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to join selected files.
* Date.....: 12/05/86
* I/O Files: Files as selected by user.
* Called By: TIGER.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables: FILEONE, FILETWO, NEWFILE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 13,79 DOUBLE
   @ 3,26 SAY [J O I N   F I L E S   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,29 SAY [1. LIST EXISTING FILES]
   @  8,29 SAY [2. JOIN FILES]
   @  9,29 SAY [3. JOIN TO FORM SPECS]
   @ 11, 29 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 13,33 SAY " select     "
   @ 13,42 GET selectnum PICTURE "9" RANGE 0,3
   READ

   DO CASE
      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO LIST EXISTING FILES
         DO PRINT
         DIR *.DBF
         SET PRINT OFF
         SET CONFIRM OFF
         STORE ' ' TO wait_subst
         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
         READ
         SET CONFIRM ON
```

```
CASE selectnum = 2
*  DO JOIN FILES
   ACCEPT [Enter filename 1...] TO FILEONE
   ACCEPT [Enter filename 2...] TO FILETWO
   ACCEPT [Enter new filename...]  TO NEWFILE
   SELECT A
   USE &FILEONE
   SELECT B
   USE &FILETWO
   JOIN WITH &FILEONE TO &NEWFILE FOR MODEL=A->MODEL

CASE selectnum = 3
* DO JOIN TO FORM SPECS

    SELECT A
    USE CHAR
    SELECT B
    USE AIRCRAFT
    JOIN WITH CHAR TO TJOIN1 FOR MODEL=A->MODEL

    SELECT A
    USE PERFORMA
    SELECT B
    USE TJOIN1
    JOIN WITH PERFORMA TO TJOIN2 FOR MODEL=A->MODEL

    SELECT A
    USE RATIOS
    SELECT B
    USE TJOIN2
    JOIN WITH RATIOS TO TJOIN3 FOR MODEL=A->MODEL

    SELECT A
    USE WEIGHT
    SELECT B
    USE TJOIN3
    JOIN WITH WEIGHT TO TJOIN4 FOR MODEL=A->MODEL

    SELECT A
    USE FATIGUE
    SELECT B
    USE TJOIN4
    JOIN WITH FATIGUE TO TJOIN5 FOR MODEL=A->MODEL

    SELECT A
    USE FLIGHT
    SELECT B
    USE TJOIN5
    JOIN WITH FLIGHT TO TJOIN6 FOR MODEL=A->MODEL
```

```
          SELECT A
          USE STATIC
          SELECT B
          USE TJOIN6
          JOIN WITH STATIC TO TJOIN7 FOR MODEL=A->MODEL

          ERASE SPECS.DBF
          SELECT A
          USE WIND
          SELECT B
          USE TJOIN7
          JOIN WITH WIND TO SPECS FOR MODEL=A->MODEL

          CLOSE ALL

          ERASE TJOIN1.DBF
          ERASE TJOIN2.DBF
          ERASE TJOIN3.DBF
          ERASE TJOIN4.DBF
          ERASE TJOIN5.DBF
          ERASE TJOIN6.DBF
          ERASE TJOIN7.DBF

*         SET CONFIRM OFF
*         STORE ' ' TO wait_subst
*         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*         READ
*         SET CONFIRM ON
*         SET STATUS ON

ENDCASE

ENDDO T

RETURN

* EOF: JOINFILE.PRG

^Z
```

```
* Program..: LISANY.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to view any selected file's structure.
* Date.....: 01/01/80
* I/O Files: Any files selected by user.
* Called By: TIGER.PRG, LISTMENU.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables: LISTNAME

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 12,79 DOUBLE
   @ 3,18 SAY [L I S T   A N Y   S T R U C T U R E   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,30 SAY [1. DISPLAY STRUCTURES]
   @  8,30 SAY [2. LIST FILES]
   @ 10, 30 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select     "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2
   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO DISPLAY STRUCTURES
         ACCEPT [Enter filename...] TO LISTNAME
         USE &LISTNAME
         DO PRINT
         DISPLAY STRUCTURE
         SET CONFIRM ON
         STORE ' ' TO wait_subst
         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
         READ
         SET CONFIRM ON
```

```
    CASE selectnum = 2
    *  DO LIST FILES
       DO PRINT
       DIR *.DBF
       SET PRINT OFF
       SET CONFIRM ON
       STORE ' ' TO wait_subst
       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
       READ
       SET CONFIRM OFF

ENDCASE

ENDDO T

RETURN

* EOF: LISANY.PRG

^Z
```

```
* Program..: LISBASIC.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to view the structure of the basic files
* Date.....: 12/06/86
* I/O Files: The nine basic database files.
* Called By: TIGER.PRG, LISTMENU.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 19,79 DOUBLE
   @ 3,15 SAY [L I S T   B A S I C   S T R U C T U R E   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. AIRCRAFT]
   @  8,31 SAY [2. CHARACTERISTICS]
   @  9,31 SAY [3. PERFORMANCE]
   @ 10,31 SAY [4. RATIOS/FACTORS]
   @ 11,31 SAY [5. WEIGHT]
   @ 12,31 SAY [6. FATIGUE TEST]
   @ 13,31 SAY [7. FLIGHT TEST]
   @ 14,31 SAY [8. STATIC TEST]
   @ 15,31 SAY [9. WIND TUNNEL TEST]
   @ 17, 31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 19,33 SAY " select    "
   @ 19,42 GET selectnum PICTURE "9" RANGE 0,9
   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN
```

```
CASE selectnum = 1
*   DO AIRCRAFT
    USE AIRCRAFT
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 2
*   DO CHARACTERISTICS
    USE CHAR
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 3
*   DO PERFORMANCE
    USE PERFORMA
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 4
*   DO RATIOS/FACTORS
    USE RATIOS
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON
```

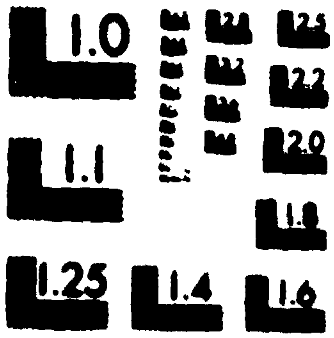
```
CASE selectnum = 5
*   DO WEIGHT
    USE WEIGHT
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 6
*   DO FATIGUE TEST
    USE FATIGUE
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 7
*   DO FLIGHT TEST
    USE FLIGHT
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 8
*   DO STATIC TEST
    USE STATIC
    DO PRINT
    LIST STRUCTURE
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON
```

```
        CASE selectnum = 9
        *   DO WIND TUNNEL TEST
            USE WIND
            DO PRINT
            LIST STRUCTURE
            SET PRINT OFF
            SET CONFIRM OFF
            STORE ' ' TO wait_subst
            @ 23,0 SAY 'Press any key to continue...' GET wait_subst
            READ
            SET CONFIRM ON

    ENDCASE

    ENDDO T

    RETURN

    * EOF: LISBASIC.PRG

    ^Z
```

```
* Program..: LISTMENU.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to view a file's structure.
* Date.....: 01/01/80
* I/O Files: NONE
* Called By: TIGER.PRG
* Calls Mod: LISBASIC.PRG, LISANY.PRG
* Reserved.: selectnum
* Variables: NONE

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 12,79 DOUBLE
   @ 3,22 SAY [L I S T   S T R U C T U R E   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,30 SAY [1. LIST BASIC STRUCTURES]
   @  8,30 SAY [2. LIST ANY STRUCTURE]
   @ 10, 30 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select     "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2
   READ

   DO CASE

      CASE selectnum = 0
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO LIST BASIC STRUCTURES
         DO LISBASIC
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON
```

AD-A181 466 COST ANALYSIS FOR AIRCRAFT SYSTEM TEST AND EVALUATION: EMPIRICAL SURVEY D..(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA W J FOSTER ET AL. MAR 87 2/3

UNCLASSIFIED F/G 5/3 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

```
      CASE selectnum = 2
      *   DO LIST ANY STRUCTURE
          DO LISANY
*         SET CONFIRM OFF
*         STORE ' ' TO wait_subst
*         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*         READ
*         SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: LISTMENU.PRG

^Z
```

```
* Program..: MODMENU.PRG
* Author...: TUN'S TIGERS
* Purpose..: Allows user to select type of record modifcation.
* Date.....: 02/18/87
* I/O Files: NONE
* Called By: TIGER.PRG
* Calls Mod: ADDMOD.PRG, EDITREC.PRG, DELRMENU.PRG
* Reserved.: selectnum
* Variables:

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE OFF
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 13,79 DOUBLE
   @ 3,23 SAY [M O D I F Y   R E C O R D S   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,33 SAY [1. ADD AIRCRAFT MODEL]
   @  8,33 SAY [2. EDIT RECORDS]
   @  9,33 SAY [3. DELETE RECORDS]
   @ 11, 33 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 13,33 SAY " select     "
   @ 13,42 GET selectnum PICTURE "9" RANGE 0,3
   READ

   DO CASE

      CASE selectnum = 0
         SET BELL ON
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO ADD AIRCRAFT MODEL
         DO ADDMOD
         SET CONFIRM OFF
         STORE ' ' TO wait_subst
         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
         READ
         SET CONFIRM ON
```

```
    CASE selectnum = 2
    *  DO EDIT RECORDS
       DO EDITREC
       SET CONFIRM OFF
       STORE ' ' TO wait_subst
       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
       READ
       SET CONFIRM ON

    CASE selectnum = 3
    *  DO DELETE RECORDS
       DO DELRMENU
       SET CONFIRM OFF
       STORE ' ' TO wait_subst
       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
       READ
       SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: MODMENU.PRG

^Z
```

```
* Program..: PRINT.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to send output to printer if desired.
* Date.....: 12/06/86
* I/O Files: NONE
* Called By: BROWANY.PRG, CQUERYMENU.PRG, CREPORTMENU.PRG,
*            JOINFILE.PRG, LISBASIC.PRG, LISANY.PRG,
*            PRINTANY.PRG, PRINTBASIC.PRG
* Calls Mod: NONE
* Reserved.: selectnum
* Variables: ANSWER

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET ECHO OFF

* Select output media

STORE " " TO ANSWER
WAIT  [Direct the output to the printer? (Y/N)] TO ANSWER

IF UPPER(ANSWER)="Y"
    SET PRINT ON
    RETURN
ELSE
    RETURN
ENDIF

* EOF:  PRINT.PRG

^Z
```

```
* Program..: PRINTANY.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows the user to print any report.
* Date.....: 02/19/87
* I/O Files: ANY REPORT FILES SELECTED BY USER
* Called By: TIGER.PRG, PRPTMENU.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables:

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE OFF
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 12,79 DOUBLE
   @ 3,20 SAY [P R I N T   A N Y   R E P O R T   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,33 SAY [1. PRINT ANY REPORT]
   @  8,33 SAY [2. LIST REPORTS]
   @ 10, 33 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select    "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2
   READ

   DO CASE

      CASE selectnum = 0
         SET BELL ON
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO PRINT ANY REPORT
         ACCEPT [Enter DBF filename...] TO DBFFILE
         ACCEPT [Enter Report Name....] TO RPTFILE
         USE &DBFFILE
         DO PRINT
         REPORT FORM &RPTFILE
         SET PRINTER OFF
         SET CONFIRM OFF
         STORE ' ' TO wait_subst
         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
         REA
         SET CONFIRM ON
```

```
      CASE selectnum = 2
      *  DO LIST REPORTS
         DO PRINT
         DIR *.FRM
         SET PRINT OFF
         SET CONFIRM OFF
         STORE ' ' TO wait_subst
         @ 23,0 SAY 'Press any key to continue...' GET wait_subst
         READ
         SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: PRINTANY.PRG

^Z
```

```
* Program..: PRINTBASIC.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows the user to print any report available.
* Date.....: 02/19/87
* I/O Files: AIRCRAFT.DBF, CHAR.DBF, PERFORMA.DBF, RATIOS.DBF,
*            WEIGHT.DBF, FATIGUE.DBF, FLIGHT.DBF, STATIC.DBF,
*            WIND.DBF
* Called By: TIGER.PRG, PRPTMENU.PRG
* Calls Mod: PRINT.PRG
* Reserved.: selectnum
* Variables:

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE OFF
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 19,79 DOUBLE
   @ 3,18 SAY [P R I N T   B A S I C   R E P O R T   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. AIRCRAFT]
   @  8,31 SAY [2. CHARACTERISTICS]
   @  9,31 SAY [3. PERFORMANCE]
   @ 10,31 SAY [4. RATIOS/FACTORS]
   @ 11,31 SAY [5. WEIGHT]
   @ 12,31 SAY [6. FATIGUE TEST]
   @ 13,31 SAY [7. FLIGHT TEST]
   @ 14,31 SAY [8. STATIC TEST]
   @ 15,31 SAY [9. WIND TEST]
   @ 17,31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 19,33 SAY " select     "
   @ 19,42 GET selectnum PICTURE "9" RANGE 0,9
   READ

   DO CASE

      CASE selectnum = 0
         SET BELL ON
         SET TALK ON
         CLEAR ALL
         RETURN
```

```
CASE selectnum = 1
*   DO AIRCRAFT
    USE AIRCRAFT
    DO PRINT
    REPORT FORM AIRRPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 2
*   DO CHAR
    USE CHAR
    DO PRINT
    REPORT FORM CHARPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 3
*   DO PERFORMANCE
    USE PERFORMA
    DO PRINT
    REPORT FORM PERRPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 4
*   DO RATIOS
    USE RATIOS
    DO PRINT
    REPORT FORM RATRPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON
```

```
CASE selectnum = 5
*   DO WEIGHT
    USE WEIGHT
    DO PRINT
    REPORT FORM WGTRPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 6
*   DO FATIGUE
    USE FATIGUE
    DO PRINT
    REPORT FORM FATRPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 7
*   DO FLIGHT
    USE FLIGHT
    DO PRINT
    REPORT FORM FLTRPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON

CASE selectnum = 8
*   DO STATIC
    USE STATIC
    DO PRINT
    REPORT FORM STARPT.FRM
    SET PRINT OFF
    SET CONFIRM OFF
    STORE ' ' TO wait_subst
    @ 23,0 SAY 'Press any key to continue...' GET wait_subst
    READ
    SET CONFIRM ON
```

```
        CASE selectnum = 9
        *   DO WIND
            USE WIND
            DO PRINT
            REPORT FORM WNDRPT.FRM
            SET PRINT OFF
            SET CONFIRM OFF
            STORE ' ' TO wait_subst
            @ 23,0 SAY 'Press any key to continue...' GET wait_subst
            READ
            SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: PRINTBASIC.PRG

^Z
```

```
* Program..: PRPTMENU.PRG
* Author...: TUNG'S TIGERS
* Purpose..: Allows user to print selected reports
* Date.....: 02/19/87
* I/O Files: NONE
* Called By: TIGER.PRG
* Calls Mod: PRINTBASIC.PRG, PRINTANY.PRG, PRINT.PRG
* Reserved.: selectnum
* Variables:

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE OFF
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 12,79 DOUBLE
   @ 3,23 SAY [P R I N T   R E P O R T S   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,31 SAY [1. PRINT BASIC REPORTS]
   @  8,31 SAY [2. PRINT ANY REPORT]
   @ 10, 31 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 12,33 SAY " select     "
   @ 12,42 GET selectnum PICTURE "9" RANGE 0,2
   READ

   DO CASE

      CASE selectnum = 0
         SET BELL ON
         SET TALK ON
         CLEAR ALL
         RETURN

      CASE selectnum = 1
      *  DO PRINT BASIC REPORTS
         DO PRINTBASIC
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON
```

```
    CASE selectnum = 2
      *  DO PRINT ANY REPORT
         DO PRINTANY
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

ENDCASE

ENDDO T

RETURN

* EOF: PRPTMENU.PRG

^Z
```

```
* Program..: TIGER.PRG
* Author...: TUNG'S TIGERS
* Date.....: 02/18/87
* Purpose..: This program assists the user in the selection of
*            actions to be performed on the database.
* I/O Files: None
* Called by: None
* Calls Mod: BROWMENU.PRG, CREPORTMENU.PRG, CQUERYMENU.PRG,
*            JOINFILE.PRG, LISTMENU.PRG, MODMENU.PRG,
*            PRINTMENU.PRG
* Reserved.: selectnum
* Variables: None

SET TALK OFF
SET BELL OFF
SET STATUS ON
SET ESCAPE ON
SET CONFIRM OFF

DO WHILE .T.
SET COLOR TO GR+/B+
   * ---Display menu options, centered on the screen.
   *    draw menu border and print heading
   CLEAR
   @ 2, 0 TO 17,79 DOUBLE
   @ 3,26 SAY [T I G E R   M A I N   M E N U]
   @ 4,1 TO 4,78 DOUBLE
   * ---display detail lines
   @  7,32 SAY [1. LIST STRUCTURES]
   @  8,32 SAY [2. BROWSE FILES]
   @  9,32 SAY [3. JOIN FILES]
   @ 10,32 SAY [4. MODIFY RECORDS]
   @ 11,32 SAY [5. CREATE REPORTS]
   @ 12,32 SAY [6. CREATE QUERIES]
   @ 13,32 SAY [7. PRINT REPORTS]
   @ 15, 32 SAY '0. EXIT'
   STORE 0 TO selectnum
   @ 17,33 SAY " select     "
   @ 17,42 GET selectnum PICTURE "9" RANGE 0,7
   READ

   DO CASE

      CASE selectnum = 0
         SET BELL ON
         SET TALK ON
         CLEAR ALL
         RETURN
```

```
     CASE selectnum = 1
     *  DO LIST STRUCTURES
        DO LISTMENU
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

     CASE selectnum = 2
     *  DO BROUSE FILES
        DO BROWMENU
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

     CASE selectnum = 3
     *  DO JOIN FILES
        DO JOINFILE
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

     CASE selectnum = 4
     *  DO MODIFY RECORDS
        DO MODMENU
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

     CASE selectnum = 5
     *  DO CREATE REPORTS
        DO CREPORTMENU
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON

     CASE selectnum = 6
     *  DO CREATE QUERIES
        DO CQUERYMENU
*       SET CONFIRM OFF
*       STORE ' ' TO wait_subst
*       @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*       READ
*       SET CONFIRM ON
```

```
      CASE selectnum = 7
      *  DO PRINT REPORTS
         DO PRPTMENU
*        SET CONFIRM OFF
*        STORE ' ' TO wait_subst
*        @ 23,0 SAY 'Press any key to continue...' GET wait_subst
*        READ
*        SET CONFIRM ON

ENDCASE

ENDDO T

SET COLOR TO W+/B+,GR+/R+, BG+

RETURN

* EOF: TIGER.PRG

^Z
```

APPENDIX C: DATA STRUCTURES

Structure for database: C:AIRCRAFT.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	MISSION	Character	10	
3	MFG	Character	20	
** Total **			41	

Structure for database: C:CHAR.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	CREW	Numeric	2	
3	FIRST_FLT	Numeric	5	2
4	AWA	Numeric	4	
5	VOL	Numeric	5	
6	WL	Numeric	5	1
7	CQ	Numeric	1	
8	AVBX	Numeric	2	
9	ENG	Numeric	1	
10	SSTA	Numeric	2	
11	THRUST	Numeric	6	
** Total **			44	

Structure for database: C.PERFORMA.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	VMAXA	Numeric	4	
3	VMAXS	Numeric	3	
4	VCRUISE	Numeric	3	
5	CBT_CEIL	Numeric	5	
6	SER_CEIL	Numeric	6	
7	CBT_RADIUS	Numeric	5	
** Total **			37	

Structure for database: C:RATIOS.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	LLF	Numeric	6	3
3	ULF	Numeric	6	3
4	WE/WS	Numeric	6	4
5	WE/VOL	Numeric	7	4
6	GTOW/WS	Numeric	6	4
** Total **			42	

Structure for database: C:WEIGHT.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field name	Type	Width	Dec
1	MODEL	Character	10	
2	WS	Numeric	6	
3	WA	Numeric	6	
4	WE	Numeric	6	
5	GTOW	Numeric	6	
6	WAVU	Numeric	4	
7	WAVI	Numeric	4	
8	MAXWSS	Numeric	6	
** Total **			49	

Structure for database: C:FATIGUE.dbf
Number of data records: 38
Date of lat update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	FTMOS	Numeric	3	
3	FTHRS	Numeric	6	1
4	FENGHRS	Numeric	6	1
5	FMFGHRS	Numeric	6	1
6	FTOOLHR	Numeric	6	1
7	FQCHRS	Numeric	6	1
8	FILSHRS	Numeric	6	1
9	FTOTHRS	Numeric	6	1
** Total **			56	

Structure for database: C:FLIGHT.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	FLTHRS	Numeric	6	
3	TEVTS	Numeric	6	
4	ENGHR	Numeric	6	1
5	MFGHR	Numeric	6	1
6	TOOLHR	Numeric	6	1
7	QCHR	Numeric	6	1
8	ILSHR	Numeric	6	1
9	TOTHRS	Numeric	6	1
** Total **			59	

Structure for database: C:STATIC.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	STMOS	Numeric	3	
3	SENGHRS	Numeric	6	1
4	SMFGHRS	Numeric	6	1
5	STOOLHR	Numeric	6	1
6	SQCHRS	Numeric	6	1
7	SILSHRS	Numeric	6	1
8	STOTHRS	Numeric	6	1
** Total **			50	

Structure for database: C:W1ND.dbf
Number of data records: 38
Date of last update : 02/20/87

Field	Field Name	Type	Width	Dec
1	MODEL	Character	10	
2	WTMOS	Numeric	3	
3	WTHRS	Numeric	6	1
4	WENGHRS	Numeric	6	1
5	WMFGHRS	Numeric	6	1
6	WTOOLHR	Numeric	6	1
7	WQCHRS	Numeric	6	1
8	WILSHRS	Numeric	6	1
9	WTOTHRS	Numeric	6	1
** Total **			56	

APPENDIX D: USER'S MANUAL

1. PRELIMINARY INFORMATION:

1.0 INTRODUCTION:

This User's Manual is designed to assist the NAVAIR Cost Systems, Research and Methods personnel in the use of the programs. All of the programs used are MENU DRIVEN to make this system as user friendly as possible. This manual is not designed to replace a programmer's guide.

***** This manual presupposes a basic working knowledge of dBASE III+ ASSIST functions. The three asterisks (***) symbol is used as a prompt in this manual to alert the user when the ASSIST function is required to complete the menu option.**

1.1 TIGER MAIN MENU:

Allows the user to select what basic actions are to be performed on the database. The selections are:

1. LIST STRUCTURES
2. BROWSE FILES
3. JOIN FILES
4. MODIFY RECORDS
5. CREATE REPORTS
6. CREATE QUERIES
7. PRINT REPORT

0\. EXIT (to dBASE III+ ASSIST menu)

1.2 LIST STRUCTURES:

Allows the user to view the structure of a file. The selections are:

1. LIST BASIC STRUCTURES
2. LIST ANY STRUCTURE

0\. EXIT (to the TIGER MAIN MENU)

1.2.1 LIST BASIC STRUCTURES:

This option allows the user to view the structure of the basic files. The selections are:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the LIST STRUCTURE MENU)

1.2.2 LIST ANY STRUCTURE:

This option allows the user to view the structure of any selected file. The selections are:

1. DISPLAY STRUCTURES
2. LIST FILES
0. EXIT (to the LIST STRUCTURE MENU)

1.3 BROWSE FILES:

When the user selects this option there are three selections available:

1. BROWSE BASIC FILES
2. BROWSE ANY FILES
3. EXIT (to the TIGER MAIN MENU)

1.3.1 BROWSE BASIC FILES:

This option allows the user to view the basic data files. The selections are:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the BROWSE FILES MENU)

1.3.2 **BROWSE ANY FILES:**

Allows the user to view the current data base files. The selections are:

1. BROWSE ANY FILE
2. LIST FILES
0. EXIT (to the BROWSE FILES MENU)

1.4 JOIN FILES:

When the user selects this option there are four selections available:

1. LIST EXISTING FILES
2. JOIN FILES
3. JOIN TO FORM SPECS
0. EXIT (to the TIGER MAIN MENU)

1.4.1 LIST EXISTING FILES:

Allows the user to view a listing of existing files.

1.4.2 JOIN FILES:

Allows the user to join files on the model field.

1.4.3 JOIN TO FORM SPECS:

Allows the user to join all the current basic files to form a specifications structure to facilitate ad hoc queries.

1.5 MODIFY RECORDS:

When the user selects this option four selections are available:

1. ADD AIRCRAFT MODEL
2. EDIT RECORDS
3. DELETE RECORDS
0. EXIT (to the TIGER MAIN MENU)

1.5.1 ADD AIRCRAFT MODEL:

This program assists the user in adding a new model aircraft to all of the nine basic files concurrently. This also does an automatic sort to place the new aircraft in alpha-numeric order.

1.5.2 EDIT RECORDS:

This program assists the user in editing records in the nine basic files. The selections are:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the MODIFY RECORDS MENU)

1.5.3 DELETE RECORDS:

This program assists the user in deleting records from the nine basic files concurrently. In addition, it displays the following selections:

1. YOU ARE ABOUT TO PERMANENTLY DELETE SELECTED RECORDS FROM FILES
0. EXIT (to the MODIFY RECORDS MENU)

1.6 CREATE REPORTS:

Allows the user to create ad hoc reports. The selections are:

1. CREATE NEW REPORT
2. LIST EXISTING REPORT FILES
0. EXIT (to the TIGER MAIN MENU)

1.6.1 CREATE NEW REPORT:

Defaults the user to the dBASE III+ ASSIST menu.

1.6.2 LIST EXISTING REPORT FILES:

Allows the user to view all report files.

1.7 CREATE QUERIES:

Allows the user to create ad hoc query relationships. The selections are:

1. CREATE NEW QUERY
2. LIST QUERY FILES
0. EXIT (to the TIGER MAIN MENU)

1.7.1 CREATE NEW QUERY:

Defaults the user to the dBASE III+ ASSIST menu.

1.7.2 LIST QUERY FILES:

Allows the user view all query files.

1.8 PRINT REPORTS:

Allows the user to print reports that come from the data files. The selections are:

1. PRINT BASIC REPORTS
2. PRINT ANY REPORT
0. EXIT (to the TIGER MAIN MENU)

1.8.1 PRINT BASIC REPORTS:

Allows the user to print the basic reports by inputing a file name.

1.8.2 PRINT ANY REPORT:

Allows the user to print a report based on the primary data files. The selections are:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST.RPT
9. WIND TUNNEL TEST.RPT
0. EXIT (to the PRINT REPORTS MENU)

2.0 INTRODUCTION:

The TIGER data base system is used to provide a relational method to input, access and compare data on the Test and Evaluation cost drivers of military aircraft. This program will allow the user to work with existing files, add data, edit data and delete records from the following nine applicable files:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST

2.1 Procedures:

This program is designed to be operated using dBASE III+ with an IBM-PC and hard disk drive to contain the required files. Ensure the required files are resident on the hard disk drive prior to operation.

1. Commands to perform.
   a. Type: DBASE (enables the db.exe file).
   b. Type: DO TIGER or F9 function key (activates main menu).

2.2 TIGER MAIN MENU:

This menu is displayed to provide the user access to the data base and the following options to view and manipulate data:

1. LIST STRUCTURES
2. BROWSE FILES
3. JOIN FILES
4. MODIFY RECORDS
5. CREATE REPORTS
6. CREATE QUERIES
7. PRINT REPORT
0. EXIT (to dBASE III+ ASSIST menu)

2.2.1 SELECTING SUB-MENUS:

Select an option from the TIGER MAIN MENU by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, 4, 5, 6, 7, or 0 <cr>

3.0 LIST STRUCTURES:

The LIST STRUCTURES menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to view and print the structure of a data file with the following selections:

1. LIST BASIC STRUCTURES
2. LIST ANY STRUCTURE
0. EXIT (to the TIGER MAIN MENU)

SELECTING LIST STRUCTURES OPTIONS:

Select an option from the LIST STRUCTURES menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2 or 0 <cr>

3.1 LIST BASIC STRUCTURES:

The LIST BASIC STRUCTURES menu is displayed when called as an option from the LIST STRUCTURES menu. This menu provides the user the opportunity to view and print the structure of the nine basic data files with the following selections:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (exit to the LIST STRUCTURES MENU)

SELECTING DATA FILE OPTIONS:

Select an option from the LIST BASIC STRUCTURES menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, 4, 5, 6, 7, 8, 9 or 0 <cr>

3.1.1 SELECTED DATA FILES:

These data files are called from the LIST BASIC STRUCTURES menu and allows the user to view and print the structure of the selected data file.

When this option is selected the monitor will query the user:

"Direct this output to the printer? (Y/N)"

If printed copy is desired:

1. Command to perform:
   a. Type: Y<cr>

If printed copy is not desired:

1. Command to perform:
   a. Type: N<cr>

After selecting Y/N the list will scroll on the screen and display the requested structure.

RETURN FROM SELECTED DATA FILE OPTION:

To return from viewing a selected data file structure, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.1.2 <u>LIST ANY STRUCTURE:</u>

The LIST ANY STRUCTURE option is called from the LIST STRUCTURES menu and allows the user to view and print the structure of any data file by typing a specific database filename.

1. Commands to perform:
   a. Type: <filename><cr>

When this option is selected the monitor will query the user:

"Direct this output to the printer? (Y/N)"

If printed copy is desired:

1. Command to perform:
   a. Type: Y<cr>

If printed copy is not desired:

1. Command to perform:
   a. Type: N<cr>

After selecting Y/N the listing will scroll on the screen and display the requested structure.

RETURN FROM LIST ANY STRUCTURE OPTION:

To return from viewing a data file, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.2 BROWSE FILES:

The BROWSE FILES menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to view but not manipulate applicable files with the following selections:

1. BROWSE BASIC FILES
2. BROWSE ANY FILE
0. EXIT (to the TIGER MAIN MENU)

SELECTING SUB-MENUS:

Select an option from the BROWSE FILES menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2 or 0 <cr>

3.2.1 BROWSE BASIC FILES:

The BROWSE BASIC FILES menu is displayed when called as an option from the BROWSE FILES menu. This menu provides the user the opportunity to view but not manipulate the nine basic data files with the following selections:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the BROWSE FILES MENU)

SELECTING DATA FILE OPTIONS:

Select an option from the BROWSE BASIC FILES menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, 4, 5, 6, 7, 8, 9 or 0 <cr>

3.2.1.1 SELECTED DATA FILES:

These data files are called from the BROWSE BASIC FILE menu and allows the user to view but not manipulate the data contained in the selected file.

RETURN FROM SELECTED DATA FILE OPTION:

To return from browsing a selected data file, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.2.2 BROWSE ANY FILE:

The BROWSE ANY FILE menu is displayed when called as an option from the BROWSE FILES menu. This menu provides the user the opportunity to view but not manipulate any files with the following selections:

1. BROWSE ANY FILE
2. LIST FILES
0. EXIT (to the BROWSE FILES MENU)

SELECTING SUB-MENU OPTIONS:

Select an option from the BROWSE ANY FILE menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2 or 0 <cr>

3.2.2.1 BROWSE ANY FILE:

The BROWSE ANY FILE option is called from the BROWSE ANY FILE menu and allows the user to view a specific database file by typing a specific database filename.

1. Commands to perform:
   a. Type: <filename><cr>

When this option is selected the monitor will query the user:

"Direct this output to the printer? (Y/N)"

If printed copy is desired:

1. Command to perform:
    a. Type: Y<cr>

If printed copy is not desired:

1. Command to perform:
    a. Type: N<cr>

After selecting Y/N the requested file will scroll on the screen.

RETURN FROM BROWSE ANY FILE OPTION:

To return from viewing a database file, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
    a. Type: <esc>

3.2.2.2 LIST FILES:

The LIST FILES option is called from the BROWSE ANY FILE menu and allows the user to view a directory listing of current database files.

RETURN FROM DATABASE FILE LISTING OPTION:

To return from viewing a database file listing, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
    a. Type: <esc>

3.3 JOIN FILES:

The JOIN FILE menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to list existing files and join files with the following selections:

1. LIST EXISTING FILES
2. JOIN FILES
3. JOIN TO FORM SPECS
0. EXIT (to the TIGER MAIN MENU)

3.3.1 LIST EXISTING FILES:

The LIST EXISTING FILES option is called from the JOIN FILE menu and allows the user to view and print a directory listing of existing database files.

When this option is selected the monitor will query the user:

"Direct this output to the printer? (Y/N)"

If printed copy is desired:

1. Command to perform:
   a. Type: Y<cr>

If printed copy is not desired:

1. Command to perform:
   a. Type: N<cr>

After selecting Y/N the requested listing will scroll on the screen.

RETURN FROM EXISTING FILES LISTING OPTION:

To return from viewing an existing files listing, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.3.2 JOIN FILES:

The JOIN FILES option is called from the JOIN FILE menu and allows the user to join two selected data files on the MODEL field with a <FILENAME> specified for the new join file.

When this option is selected the monitor will query the user:

"Enter filename 1..."

1. Commands to perform:
   a. Type: <FILENAME> <cr>

"Enter filename 2..."

1. Commands to perform:
   a. Type: <FILENAME> <cr>

"Enter new filename..."

1. Commands to perform:
   a. Type: <FILENAME> <cr>

RETURN FROM JOIN FILES OPTION:

Following entry of the desired filenames, the program will join the desired files and return to the JOIN FILE menu.

3.3.3 JOIN TO FORM SPECS:

The JOIN TO FORM SPECS option is called from the JOIN FILES MENU and allows the user to view and print a specifications structure of the existing database files.

When this option is selected the monitor will query the user:

"Direct this output to the printer? (Y/N)"

If printed copy is desired:

1. Command to perform:
   a. Type: Y<cr>

If printed copy is not desired:

1. Command to perform:
   a. Type: N<cr>

After selecting Y/N the requested specifications chart will scroll on the screen.

RETURN FROM JOIN TO FORM SPECS OPTION:

To return from viewing a specifications chart, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.4 MODIFY RECORDS:

When the user selects this option four selections are available:

1. ADD AIRCRAFT MODEL
2. EDIT RECORDS
3. DELETE RECORDS
0. EXIT (to the TIGER MAIN MENU)

3.4.1 ADD AIRCRAFT MODEL:

This program assists the user in adding a new model aircraft to all of the nine basic files concurrently. This also does an automatic sort to place the new aircraft in alpha-numeric order.

When this option is selected the monitor will query the user to input the new model:

1. Command to perform:
   a. Type: Model<cr>

RETURN FROM ADD AIRCRAFT MODEL OPTION:

To return from adding a new aircraft, the user may type <CTRL - End> which will return the screen to the previous menu.

3.4.2 EDIT RECORDS:

This program assists the user in editing records in the nine basic files. The user must be cautioned: in this selection you will be editting only the file you have selected, you will not edit all the sructures simultaneously. In addition, if you edit the model, it will only be edited in the structure selected. In order to ensure continuity among all structures you will have to individually modify the model attribute in the remaining structures. The selections are:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the MODIFY RECORDS MENU)

Select an option from the BROWSE BASIC FILES menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, 4, 5, 6, 7, 8, 9 or 0 <cr>

RETURN FROM EDIT RECORDS OPTION:

To return from editing a record, the user may type <esc> which will save the changes and return the screen to the previous menu.

3.4.3 DELETE RECORDS:

This program assists the user in deleting records from the nine basic files concurrently. It does an automatic pack to ensure the remaining models are maintained in alpha-numeric order. In addition, it displays the following selections:

1. YOU ARE ABOUT TO PERMANENTLY DELETE SELECTED RECORDS FROM FILES
0. EXIT (to the MODIFY RECORDS MENU)

RETURN FROM DELETE RECORDS OPTION:

To return from deleting a record, the user may type <esc> which will return the screen to the previous menu.

3.5 CREATE REPORT:

The CREATE REPORT menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to create an ad hoc report or view a listing of existing report files with the following selections:

1. CREATE NEW REPORT
2. LIST EXISTING REPORT FILES
0. EXIT (to the TIGER MAIN MENU)

SELECTING CREATE REPORT OPTIONS:

Select an option from the CREATE REPORT menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2 or 0 <cr>

3.5.1 CREATE NEW REPORT:

The CREATE NEW REPORT option is called from the CREATE REPORT menu and allows the user to create an ad hoc report utilizing the dBASE III+ ASSIST function.

1. Commands to perform:
   a. Type: 1

*** **a. User is directed to the dBASE III+ ASSIST function.**

RETURN FROM CREATE NEW REPORT OPTION:

To return from creating an ad hoc report, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.5.2 LIST EXISTING REPORT FILES:

The LIST EXISTING REPORT FILES option is called from the CREATE REPORT menu and allows the user to view a directory listing of existing report files.

RETURN FROM EXISTING REPORT FILES LISTING OPTION:

To return from viewing an existing report files listing, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.6 <u>CREATE QUERIES:</u>

The CREATE QUERIES menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to create ad hoc query relationships with the following selectaons:

1. CREATE NEW QUERY
2. LIST QUERY FILES
0. EXIT (to the TIGER MAIN MENU)

SELECTING CREATE QUERIES OPTIONS:

Select an option from the CREATE QUERIES menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2 or 0 <cr>

3.6.1 <u>CREATE NEW QUERY:</u>

The CREATE NEW QUERY option is displayed when called as an option from the CREATE QUERY menu. This option allows the user to create an ad hoc query using the dBASE III+ ASSIST function.

1. Commands to perform:
   a. Type: 1

*** **a. User is directed to the dBASE III+ ASSIST function.**

3.6.2 <u>LIST QUERY FILES:</u>

The LIST QUERY FILES option is called from the CREATE QUERY menu and allows the user to view all query files.

RETURN FROM LIST QUERY FILES OPTION:

To return from viewing a query file listing, the user may type <esc> which will return the screen to the previous menu.

1. **Commands to perform:**
   a. **Type: <esc>**

3.7 PRINT REPORTS:

The PRINT REPORTS menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to send to the printer the following selections:

1. PRINT BASIC REPORTS
2. PRINT ANY REPORT
0. EXIT (to the TIGER MAIN MENU)

SELECTING SUB-MENUS:

Select an option from the PRINT REPORTS menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, or 0 <cr>

3.7.1 PRINT BASIC REPORTS:

The PRINT BASIC REPORTS menu is displayed when called as an option from the TIGER MAIN MENU. This menu provides the user the opportunity to send to the printer nine standard reports with the following selections:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the PRINT REPORTS MENU)

SELECTING SUB-MENUS:

Select an option from the PRINT BASIC REPORTS menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, 4, 5, 6, 7, 8, 9, or 0 <cr>

RETURN FROM PRINT BASIC REPORTS OPTION:

To return from printing a basic report, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

3.7.2 PRINT ANY REPORT:

Allows the user to print a report based on the primary data files. The selections are:

1. PRINT ANY REPORT
2. LIST REPORTS
0. EXIT (to the PRINT REPORTS MENU)

3.7.2.1 PRINT ANY REPORT:

Allows the user to print a report based on the following selections:

1. AIRCRAFT
2. CHARACTERISTICS
3. PERFORMANCE
4. RATIOS/FACTORS
5. WEIGHT
6. FATIGUE TEST
7. FLIGHT TEST
8. STATIC TEST
9. WIND TUNNEL TEST
0. EXIT (to the PRINT REPORTS MENU)

SELECTING SUB-MENUS:

Select an option from the PRINT ANY REPORTS menu by typing the number of the corresponding option desired.

1. Commands to perform:
   a. Type: 1, 2, 3, 4, 5, 6, 7, 8, 9, or 0 <cr>

RETURN FROM PRINT ANY REPORTS OPTION:

To return from printing a report, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
a. Type: <esc>

3.7.2.2 <u>LIST REPORTS:</u>

Allows the user to view and print the reports that are available.

RETURN FROM LIST REPORTS OPTION:

To return from viewing or printing the available reports, the user may type <esc> which will return the screen to the previous menu.

1. Commands to perform:
   a. Type: <esc>

APPENDIX E: REPORTS

***** DUE TO THE PROPRIETARY NATURE OF THE DATA THIS THESIS WILL USE "XX" TO INDICATE WHERE SUCH DATA WAS AVAILABLE AND USED IN THE DATABASE *****

AIRCRAFT

MODEL	MISSION	MFG
A-10A	XX	XX
A-18	XX	XX
A 4A	XX	XX
A-5A	XX	XX
A-6A	XX	XX
A-7	XX	XX
AV-8B	XX	XX
B-1	XX	XX
B 45C	XX	XX
B-52F	XX	XX
B-52G	XX	XX
B-58A	XX	XX
C-130B	XX	XX
C-130E	XX	XX
C 135A	XX	XX
C-141A	XX	XX
C-5A	XX	XX
E-3A	XX	XX
F-100	XX	XX
F-105	XX	XX
F-111A	XX	XX
F-14A	XX	XX
F-15A	XX	XX
F-16A	XX	XX
F-18	XX	XX
F-4A	XX	XX
F-5	XX	XX
F-84B	XX	XX
F-86D	XX	XX
OV-10	XX	XX
S-3A	XX	XX
T-2	XX	XX
T-38A	XX	XX
T-39	XX	XX
XB-70	XX	XX
YC-130	XX	XX
YC-14	XX	XX
YF 16	XX	XX

FLIGHT TEST DATA

MODEL	FLTHRS	TEVTS	ENGHR	MFGHR	TOOLHR	QCHR	ILSHR	TOTHRS
A-10A			XX	XX	XX	XX		
A-18			XX	XX	XX	XX		
A-4A			XX	XX	XX			XX
A-5A			XX	XX		XX		XX
A-6A			XX	XX	XX	XX		XX
A-7	XX		XX					
AV-8B			XX					
B-1			XX					XX
B-45C								
B-52F			XX					XX
B-52G								
B-58A			XX	XX	XX	XX		XX
C-130B								
C-130E								
C-135A			XX					XX
C-141A	XX		XX					XX
C-5A	XX		XX			XX		XX
E-3A	XX		XX					
F-100								XX
F-105			XX	XX	XX			XX
F-111A	XX		XX	XX	XX	XX		XX
F-14A			XX	XX	XX	XX		XX
F-15A			XX	XX		XX		XX
F-16A	XX		XX	XX	XX	XX		XX
F-18			XX	XX	XX	XX		XX
F-4A			XX	XX		XX		XX
F-5								XX
F-84B								
F-86D								
OV-10			XX	XX				
S-3A	XX		XX	XX	XX	XX		XX
T-2			XX	XX				
T-38A			XX	XX	XX	XX		XX
T-39								XX
XB-70								
YC 130								
YC-14	XX		XX					XX
YF-16	XX		XX	XX	XX	XX		XX

FATIGUE TEST DATA

MODEL	TMOS	THRS	ENGHRS	MFGHRS	TOOLHR	QCHRS	ILSHRS	TOTHRS
A-10A			XX					
A-18			XX					
A-4A								
A-5A			XX	XX				
A-6A								
A-7								
AV-8B								
B-1								
B-45C								
B-52F			XX					
B-52G								
B-58A			XX	XX	XX	XX		XX
C-130B								
C-130E								
C-135A								
C-141A			XX					
C-5A			XX	XX	XX	XX		
E-3A								
F-100								
F-105								
F-111A			XX	XX	XX	XX		XX
F-14A			XX	XX	XX	XX		
F-15A								
F-16A			XX	XX	XX	XX		XX
F-18			XX					
F-4A								
F-5								
F-84B								
F-86D								
OV-10			XX	XX				
S-3A			XX	XX	XX			
T-2			XX	XX				
T-38A								
T-39								
XB-70								
YC-130								
YC-14								
YF-16								

STATIC TEST DATA

MODEL	TNOS	ENGHRS	MFGHRS	TOOLHR	QCHRS	ILSHRS	TOTHRS
A-10A		XX					
A-18		XX					
A-4A							
A-5A		XX	XX				
A-6A							
A-7							
AV-8B							
B-1							
B-45C							
B-52F		XX					
B-52G							
B-58A		XX	XX	XX	XX		XX
C-130B							
C-130E							
C-135A							XX
C-141A		XX					
C-5A		XX	XX	XX			
E-3A							
F-100							
F-105							
F-111A		XX	XX	XX	XX		XX
F-14A		XX	XX	XX	XX		
F-15A							
F-16A		XX	XX	XX	XX		
F-18		XX					
F-4A		XX					
F-5							
F-84B							
F-86D							
OV-10		XX	XX				
S-3A		XX	XX	XX			
T-2		XX	XX				
T-38A							
T-39							
XB-70							
YC-130							
YC-14							
YF-16							

WIND TUNNEL TEST DATA

MODEL	TMOS	THRS	ENGHRS	MFGHRS	TOOLHR	QCHRS	ILSHRS	TOTHRS
A-10A			XX					
A-18			XX					
A-4A			XX					
A-5A			XX	XX				
A-6A			XX					
A-7								
AV-8B								
B-1								
B-45C								
B-52F			XX					
B-52G								
B-58A			XX		XX	XX		XX
C-130B								
C-130E								
C-135A								XX
C-141A			XX					
C-5A			XX					
E-3A								
F-100								
F-105								
F-111A			XX	XX	XX	XX		XX
F-14A			XX	XX	XX	XX		
F-15A								
F-16A			XX		XX	XX		XX
F-18			XX	XX				
F-4A			XX					
F-5								
F-84B								
F-86D								
OV-10			XX	XX				
S-3A			XX	XX				
T-2								
T-38A			XX					
T-39								
XB-70								
YC-130								
YC-14			XX					
YF-16			XX		XX	XX		XX

AIRCRAFT CHARACTERISTICS

MODEL	CREW	1STFL	AWA	VOL	WL	CQ	AVBX	ENG	SSTA	THRUST
A-10A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
A-18	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
A-4A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
A-5A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
A-6A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
A-7	XX	XX			XX	XX		XX	XX	XX
AV-8B	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
B-1	XX	XX			XX	XX		XX	XX	XX
B-45C	XX									
B-52F	XX	XX			XX	XX		XX	XX	XX
B-52G	XX	XX			XX	XX		XX	XX	XX
B-58A	XX	XX			XX	XX		XX	XX	XX
C-130B	XX	XX			XX	XX		XX	XX	XX
C-130E	XX	XX			XX	XX		XX	XX	XX
C-135A	XX	XX			XX	XX		XX	XX	XX
C-141A	XX	XX			XX	XX		XX	XX	XX
C-5A	XX	XX			XX	XX		XX	XX	XX
E-3A	XX	XX			XX	XX		XX	XX	XX
F-100	XX	XX			XX	XX		XX	XX	XX
F-105	XX	XX			XX	XX		XX	XX	XX
F-111A	XX	XX			XX	XX		XX	XX	XX
F-14A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
F-15A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
F-16A	XX	XX			XX	XX	XX	XX	XX	XX
F-18	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
F-4A	XX	XX	XX		XX	XX	XX	XX	XX	XX
F-5	XX	XX			XX	XX		XX	XX	XX
F-84B	XX	XX			XX	XX		XX	XX	XX
F-86D	XX	XX			XX	XX		XX	XX	XX
OV-10	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
S-3A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
T-2	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
T-38A	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
T-39	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
XB-70	XX									
YC-130	XX	XX			XX	XX		XX		
YC-14	XX	XX			XX	XX		XX		
YF-16	XX	XX			XX	XX		XX	XX	

AIRCRAFT RATIOS/FACTORS

MODEL	LLF	ULF	WE/WS	WE/VOL	GTOW/WS
A-10A	XX	XX	XX	XX	XX
A-18	XX	XX	XX	XX	XX
A-4A	XX	XX	XX	XX	XX
A-5A	XX	XX	XX	XX	XX
A-6A	XX	XX	XX	XX	XX
A-7	XX	XX	XX	XX	XX
AV-8B	XX	XX	XX	XX	XX
B-1			XX		XX
B-45C			XX		XX
B-52F			XX		XX
B-52G			XX		XX
B-58A			XX		XX
C-130B			XX		XX
C-130E		XX	XX		XX
C-135A			XX		XX
C-141A			XX		XX
C-5A			XX		XX
E-3A			XX		XX
F-100			XX		XX
F-105					
F-111A			XX		XX
F-14A	XX	XX	XX	XX	XX
F-15A	XX	XX	XX	XX	XX
F-16A	XX	XX	XX	XX	XX
F-18	XX	XX	XX	XX	XX
F-4A	XX	XX	XX		XX
F-5					
F-84B		XX	XX		XX
F-86D			XX		XX
OV-10	XX	XX	XX	XX	XX
S-3A	XX	XX	XX	XX	XX
T-2	XX	XX	XX	XX	XX
T-38A	XX	XX	XX	XX	XX
T-39	XX	XX	XX	XX	XX
XB-70			XX		XX
YC-130					XX
YC-14					
YF-16		XX	XX		XX

AIRCRAFT WEIGHT

MODEL	WS	WA	WE	GTOW	WAVU	WAVI	MAXWSS
A-10A	XX	XX	XX	XX	XX	XX	XX
A-18	XX	XX	XX	XX	XX	XX	XX
A-4A	XX	XX	XX	XX	XX	XX	XX
A-5A	XX	XX	XX	XX	XX	XX	
A-6A	XX	XX	XX	XX	XX	XX	XX
A-7	XX	XX	XX	XX	XX	XX	XX
AV-8B	XX	XX	XX	XX	XX	XX	XX
B-1	XX	XX	XX	XX	XX	XX	
B-45C	XX		XX	XX	XX		XX
B-52F	XX		XX	XX	XX	XX	
B-52G	XX	XX	XX	XX	XX	XX	
B-58A	XX	XX	XX	XX	XX	XX	
C-130B	XX	XX	XX	XX	XX	XX	
C-130E	XX		XX	XX	XX	XX	
C-135A	XX		XX	XX	XX		
C-141A	XX		XX	XX	XX	XX	
C-5A	XX	XX	XX	XX	XX	XX	
E-3A	XX	XX	XX	XX	XX	XX	
F-100	XX		XX	XX	XX	XX	
F-105			XX	XX			
F-111A	XX	XX	XX	XX	XX	XX	
F-14A	XX	XX	XX	XX	XX	XX	
F-15A	XX	XX	XX	XX	XX	XX	
F-16A	XX	XX	XX	XX	XX	XX	
F-18	XX	XX	XX	XX	XX	XX	XX
F-4A	XX	XX	XX	XX	XX	XX	XX
F-5			XX	XX			
F-84B	XX		XX	XX	XX		
F-86D	XX	XX	XX	XX	XX	XX	
OV-10	XX	XX	XX	XX	XX	XX	XX
S-3A	XX	XX	XX	XX	XX	XX	XX
T-2	XX	XX	XX	XX	XX	XX	
T-38A	XX	XX	XX	XX	XX	XX	XX
T-39	XX	XX	XX	XX	XX	XX	
XB-70	XX		XX	XX	XX	XX	
YC-130	XX	XX		XX	XX	XX	
YC-14							
YF-16	XX	XX	XX	XX	XX	XX	

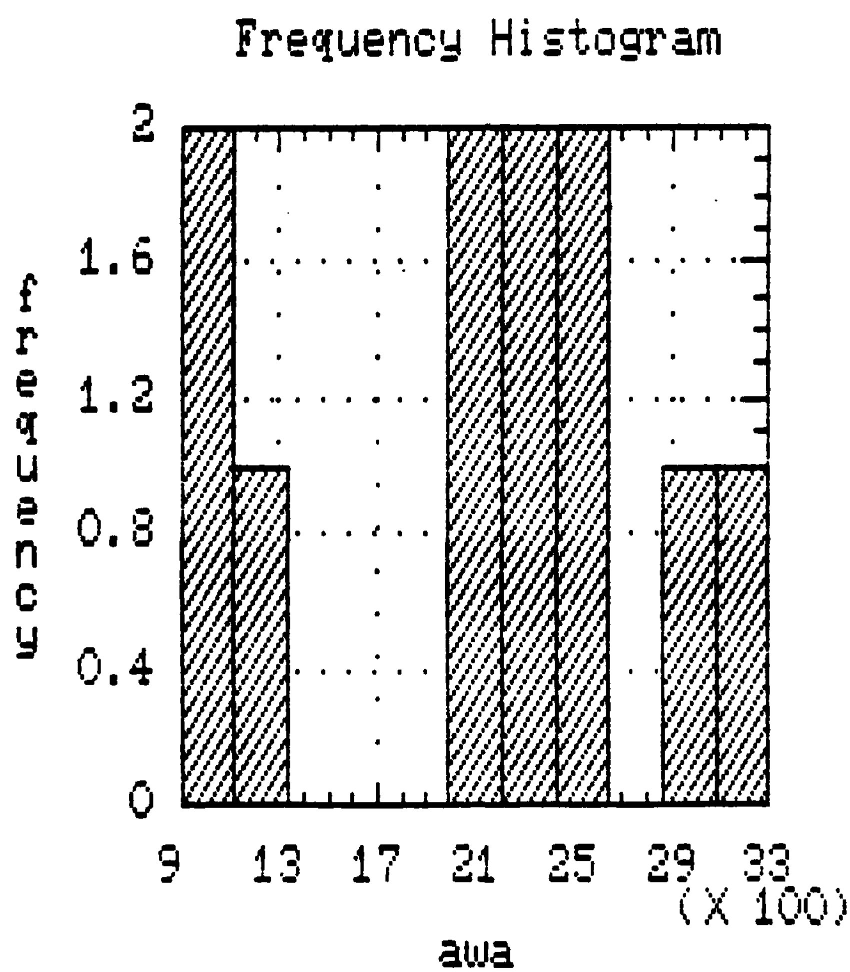
AIRCRAFT PERFORMANCE

MODEL	VMAXA	VMAXS	VCRUISE	CBTCEIL	SERCEIL	CBTRADIUS
A-10A	XX	XX	XX	XX	XX	XX
A-18	XX	XX	XX	XX		XX
A-4A	XX	XX	XX	XX	XX	XX
A-5A	XX	XX	XX	XX	XX	XX
A-6A	XX	XX	XX	XX	XX	XX
A-7	XX	XX	XX	XX	XX	XX
AV-8B	XX	XX	XX			XX
B-1	XX	XX	XX	XX	XX	XX
B-45C		XX			XX	XX
B-52F	XX			XX	XX	XX
B-52G	XX		XX			
B-58A	XX	XX		XX	XX	XX
C-130B	XX		XX			
C-130E	XX	XX	XX		XX	XX
C-135A	XX		XX	XX	XX	XX
C-141A	XX		XX	XX	XX	XX
C-5A	XX		XX	XX	XX	XX
E-3A	XX		XX			
F-100	XX		XX	XX	XX	XX
F-105	XX		XX	XX	XX	XX
F-111A	XX		XX	XX	XX	XX
F-14A	XX	XX	XX		XX	
F-15A	XX	XX	XX		XX	
F-16A	XX	XX			XX	XX
F-18	XX	XX	XX	XX		XX
F-4A	XX	XX	XX	XX	XX	XX
F-5	XX		XX	XX	XX	XX
F-84B	XX	XX	XX	XX	XX	
F-86D	XX				XX	XX
OV-10	XX	XX	XX		XX	
S-3A	XX	XX	XX		XX	XX
T-2	XX	XX	XX			
T-38A	XX	XX	XX	XX	XX	XX
T-39	XX	XX	XX	XX	XX	XX
XB-70						
YC-130						
YC-14						
YF-16						

APPENDIX F: ONE WAY ANALYSIS OF VARIANCE

One-Sample Analysis Results

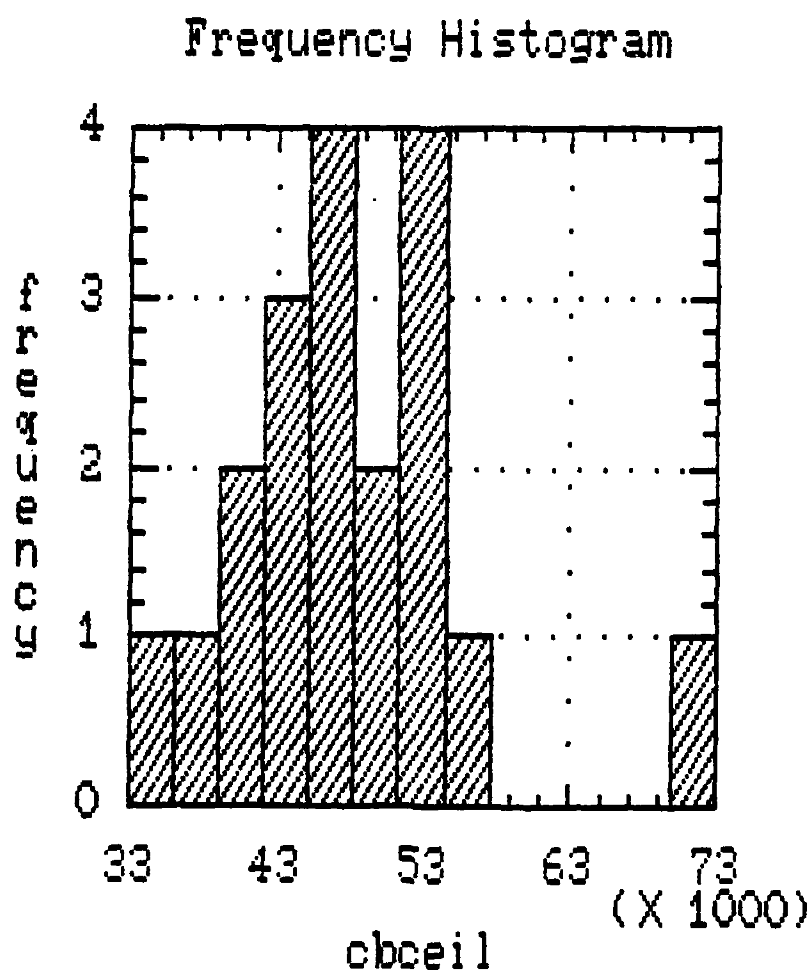
		awa		
Sample Statistics:	Number of Obs.	11		
	Average	2118.82		
	Variance	561931		
	Std. Deviation	749.62		
	Median	2217		
Confidence Interval for Mean:		95	Percent	
	Sample 1	1615.08 2622.55		10 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			
Hypothesis Test for H0: Mean = 0		Computed t statistic = 9.37451		
vs Alt: NE		Sig. Level = 2.86391E-6		
at Alpha = 0.05		so reject H0.		



One-Sample Analysis Results

		cbceil	
Sample Statistics:	Number of Obs.	19	
	Average	47805.3	
	Variance	6.64383E7	
	Std. Deviation	8150.95	
	Median	46900	
Confidence Interval for Mean:		95 Percent	
	Sample 1	43875.7 51734.9	18 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		

Hypothesis Test for HO: Mean = 0	Computed t statistic = 25.5649
vs Alt: NE	Sig. Level = 1.33227E-15
at Alpha = 0.05	so reject HO.



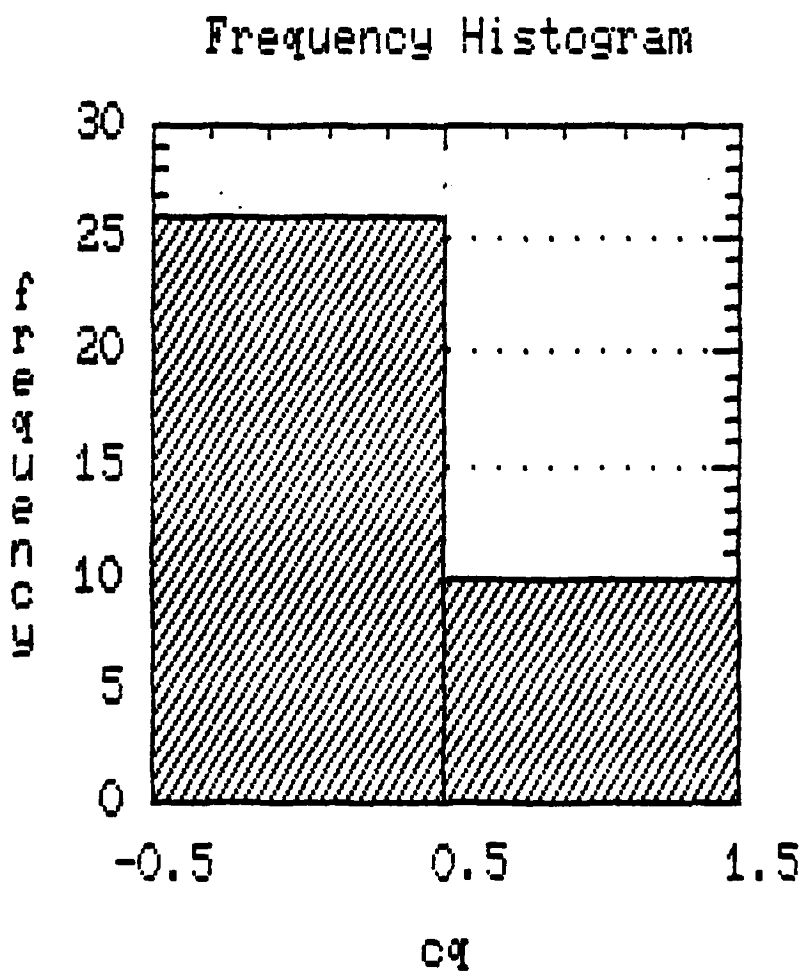
One-Sample Analysis Results

		cq
Sample Statistics:	Number of Obs.	36
	Average	0.277778
	Variance	0.206349
	Std. Deviation	0.454257
	Median	0

Confidence Interval for Mean: 95 Percent
Sample 1 0.124044 0.431512 35 D.F.

Confidence Interval for Variance: 0 Percent
Sample 1

Hypothesis Test for H0: Mean = 0 — Computed t statistic = 3.669
vs Alt: NE — Sig. Level = 8.03748E-4
at Alpha = 0.05 — so reject H0.

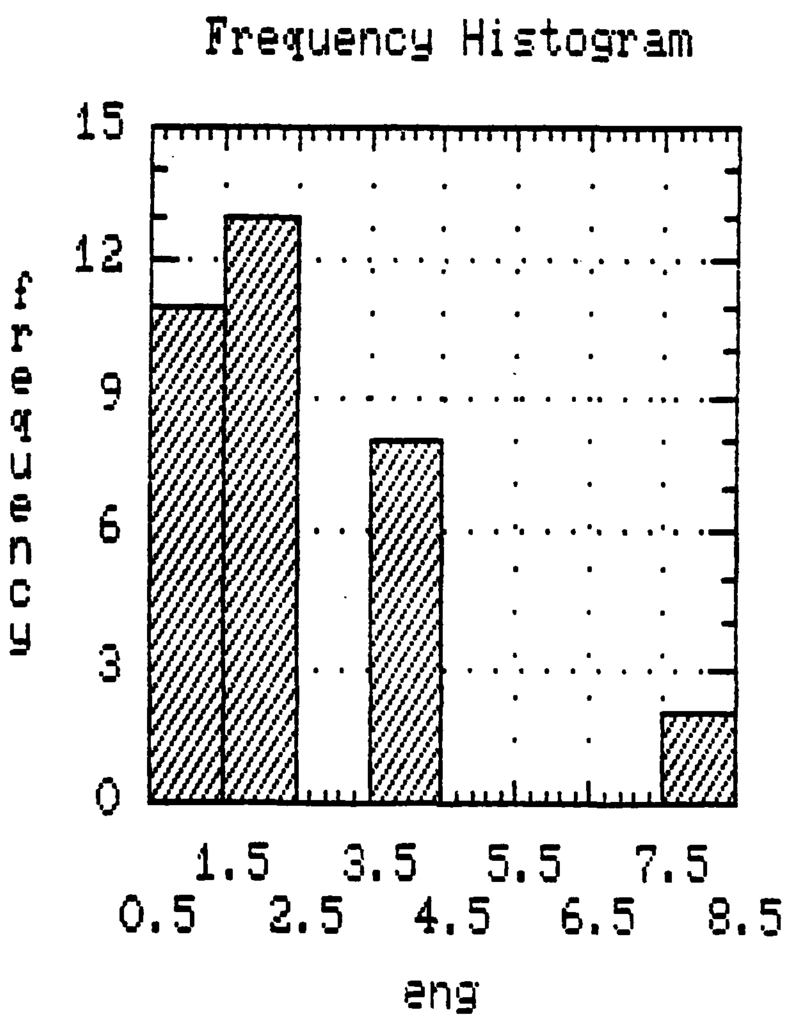


One-Sample Analysis Results

		eng		
Sample Statistics:	Number of Obs.	34		
	Average	2.5		
	Variance	3.22727		
	Std. Deviation	1.79646		
	Median	2		
Confidence Interval for Mean:		95	Percent	
	Sample 1	1.87304 3.12696		33 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			

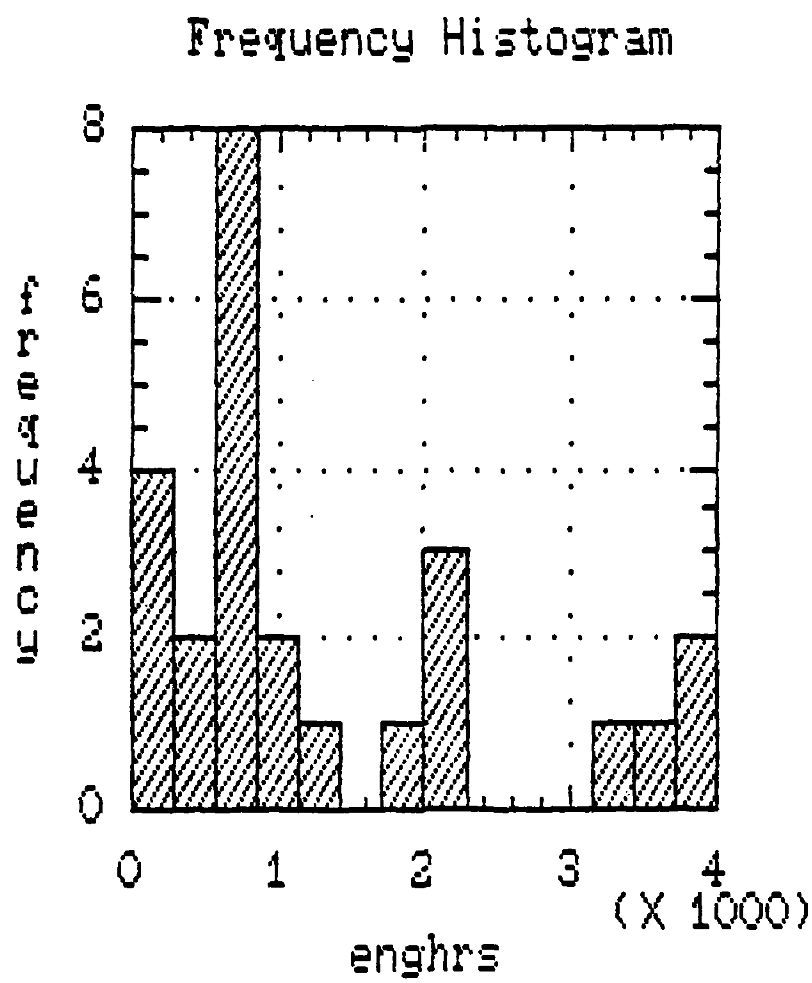
Hypothesis Test for H0: Mean = 0 vs Alt: NE at Alpha = 0.05

Computed t statistic = 8.1145
Sig. Level = 2.2925E-9
so reject H0.



One-Sample Analysis Results

		enghrs	
Sample Statistics:	Number of Obs.	25	
	Average	1350.06	
	Variance	1.39592E6	
	Std. Deviation	1181.49	
	Median	820	
Confidence Interval for Mean:		95 Percent	
	Sample 1	862.244 1837.87	24 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 5.71335	
	vs Alt: NE	Sig. Level = 6.92241E-6	
	at Alpha = 0.05	so reject H0.	



One-Sample Analysis Results

		ff
Sample Statistics:	**Number of Obs.**	31
	Average	11.0458
	Variance	77.5108
	Std. Deviation	8.80402
	Median	8.33

Confidence Interval for Mean: 95 Percent

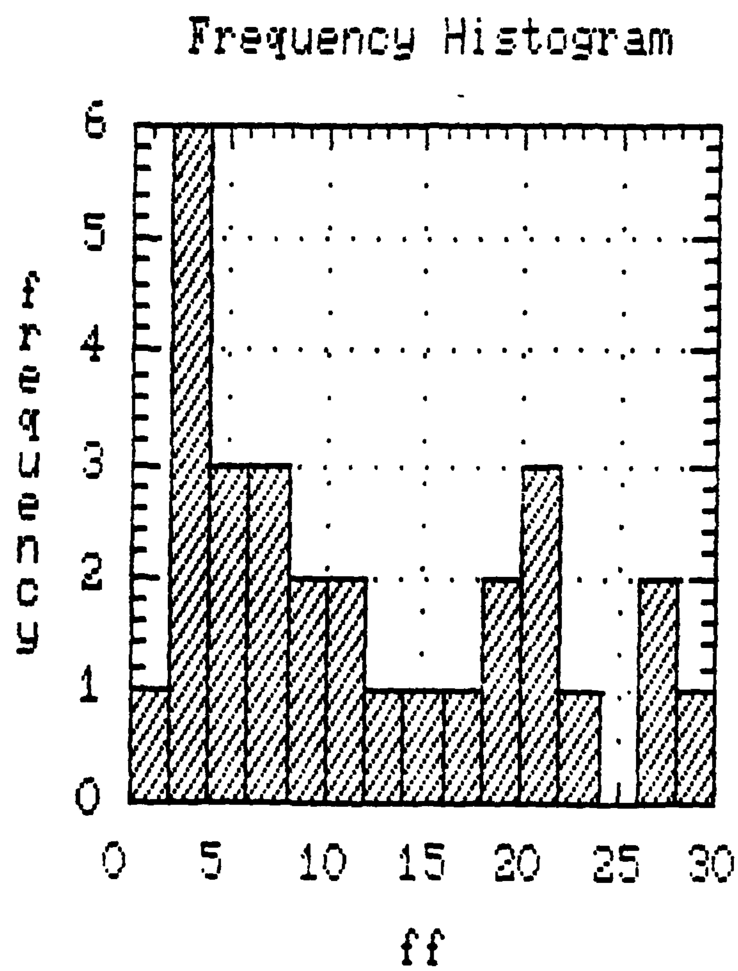
Sample 1 7.81571 14.2759 30 D.F.

Confidence Interval for Variance: 0 Percent

Sample 1

Hypothesis Test for H0: Mean = 0 vs Alt: NE at Alpha = 0.05

Computed t statistic = 6.9855
Sig. Level = 9.22532E-8
so reject H0.



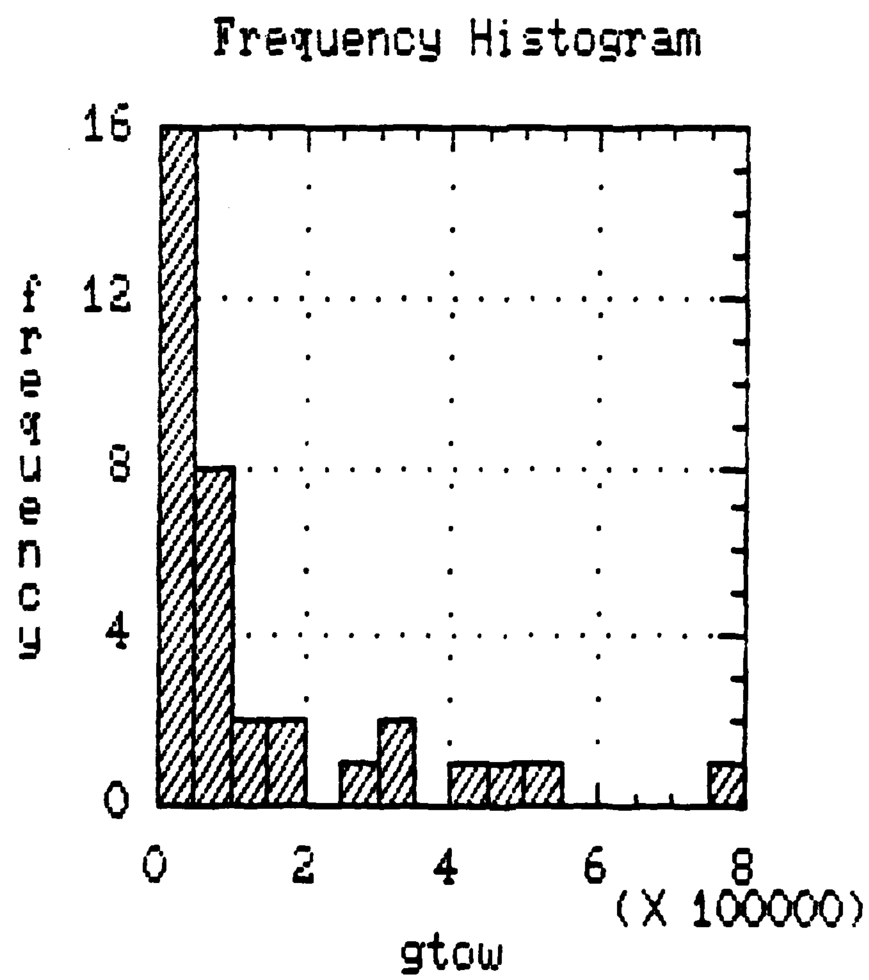
One-Sample Analysis Results

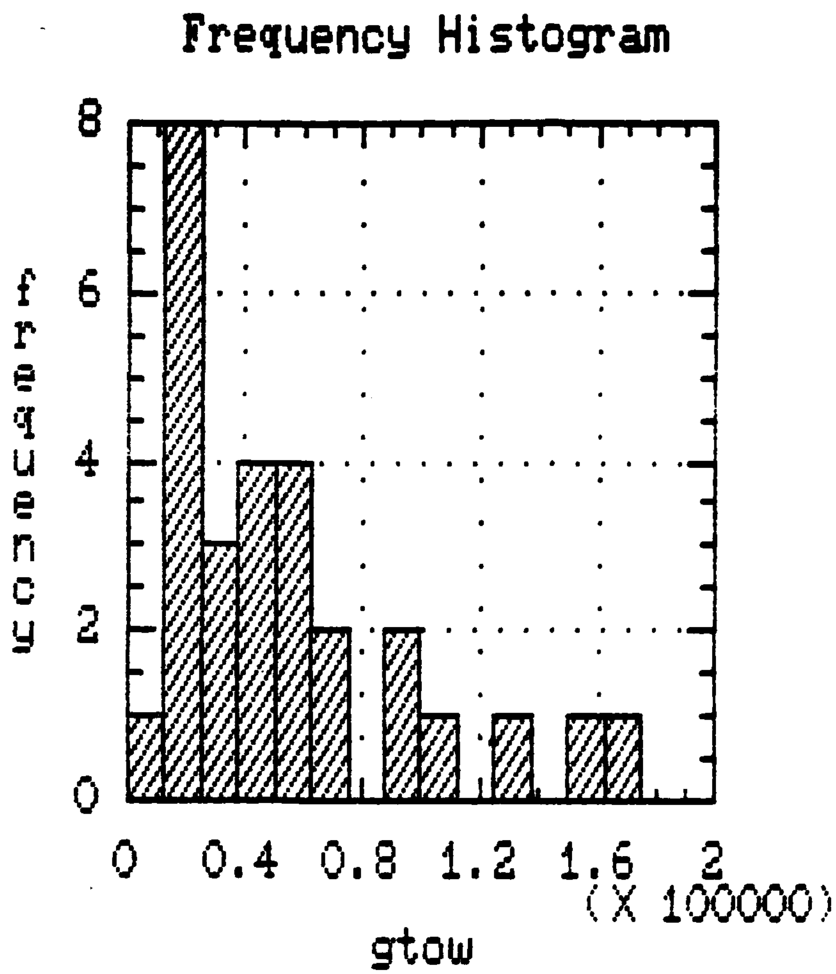
		gtow
Sample Statistics:	Number of Obs.	35
	Average	134429
	Variance	3.25712E10
	Std. Deviation	180475
	Median	56000

Confidence Interval for Mean: 95 Percent
Sample 1 72419 196438 34 D.F.

Confidence Interval for Variance: 0 Percent
Sample 1

Hypothesis Test for HO: Mean = 0 vs Alt: NE at Alpha = 0.05
Computed t statistic = 4.40666
Sig. Level = 9.95387E-5
so reject HO.

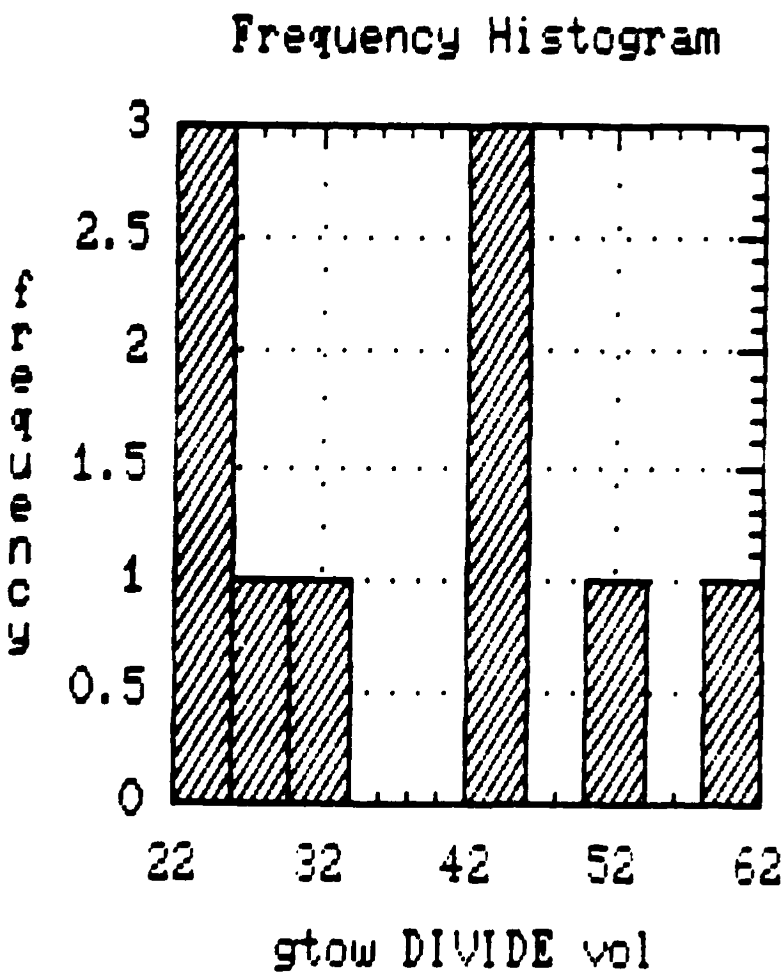




Frequency Histogram
frequency
0
2
4
6
8
0
0.4
0.8
1.2
1.6
2
(X 100000)
gtow

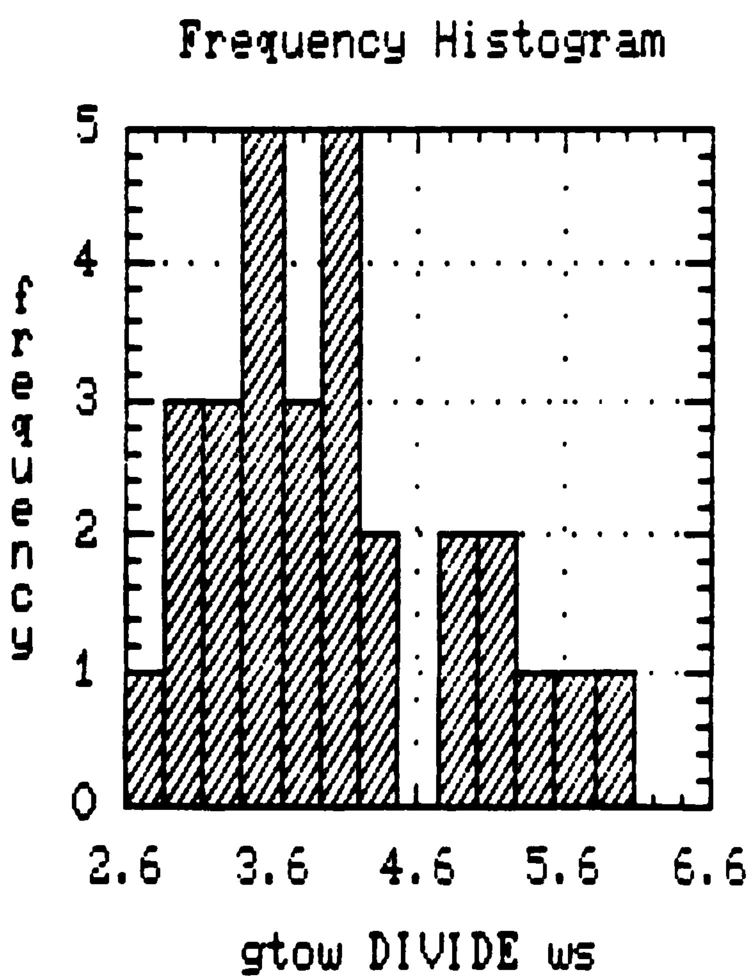
One-Sample Analysis Results

		gtow DIVIDE vol	
Sample Statistics:	Number of Obs.	10	
	Average	37.0008	
	Variance	158.864	
	Std. Deviation	12.6041	
	Median	36.313	
Confidence Interval for Mean:		95 Percent	
	Sample 1	27.9819 46.0197	9 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 9.2832	
	vs Alt: NE	Sig. Level = 6.6219E-6	
	at Alpha = 0.05	so reject H0.	



One-Sample Analysis Results

		gtow DIVIDE ws	
Sample Statistics:	Number of Obs.	29	
	Average	4.02412	
	Variance	0.747225	
	Std. Deviation	0.864422	
	Median	3.86238	
Confidence Interval for Mean:		95 Percent	
	Sample 1	3.69524 4.35301	28 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for HO: Mean = 0		Computed t statistic = 25.0694	
	vs Alt: NE	Sig. Level = 0	
	at Alpha = 0.05	so reject HO.	



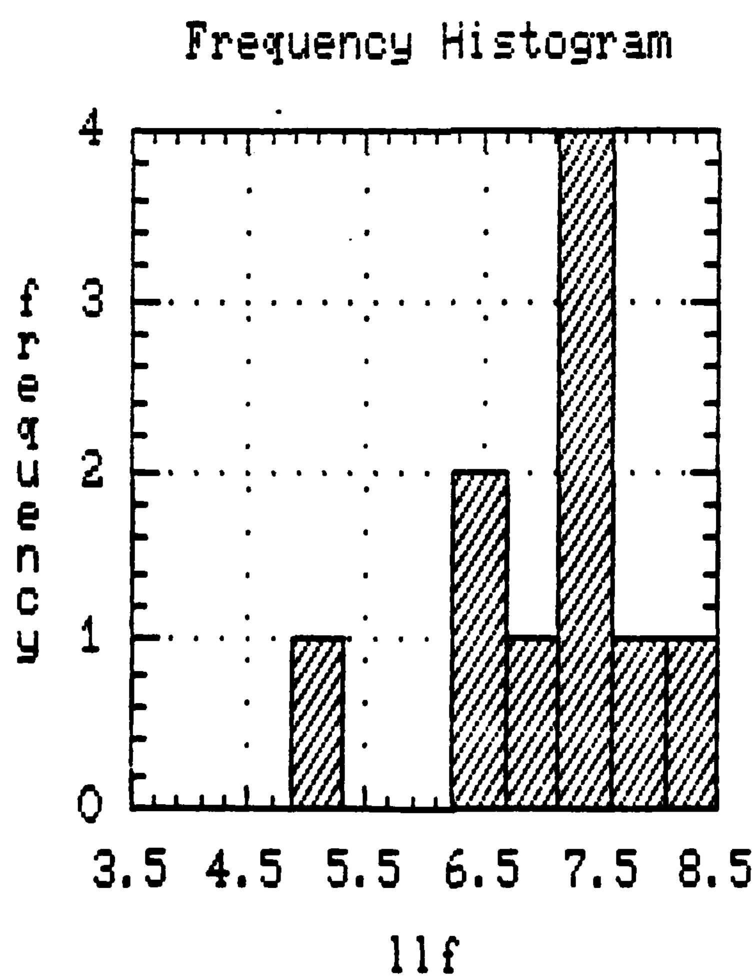
One-Sample Analysis Results

		llf
Sample Statistics:	Number of Obs.	11
	Average	6.77264
	Variance	2.0014
	Std. Deviation	1.41471
	Median	7.333

Confidence Interval for Mean: 95 Percent
Sample 1 5.82197 7.7233 10 D.F.

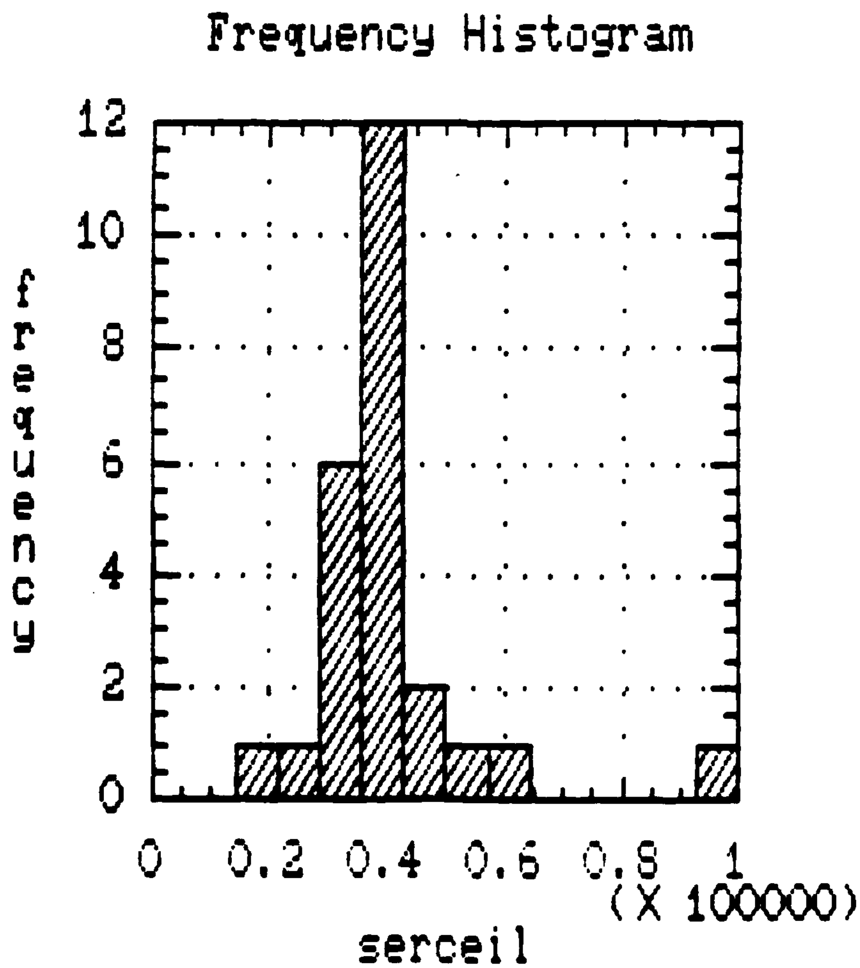
Confidence Interval for Variance: 0 Percent
Sample 1

Hypothesis Test for HO: Mean = 0 vs Alt: NE at Alpha = 0.05
Computed t statistic = 15.8777
Sig. Level = 2.02201E-8
so reject HO.



One-Sample Analysis Results

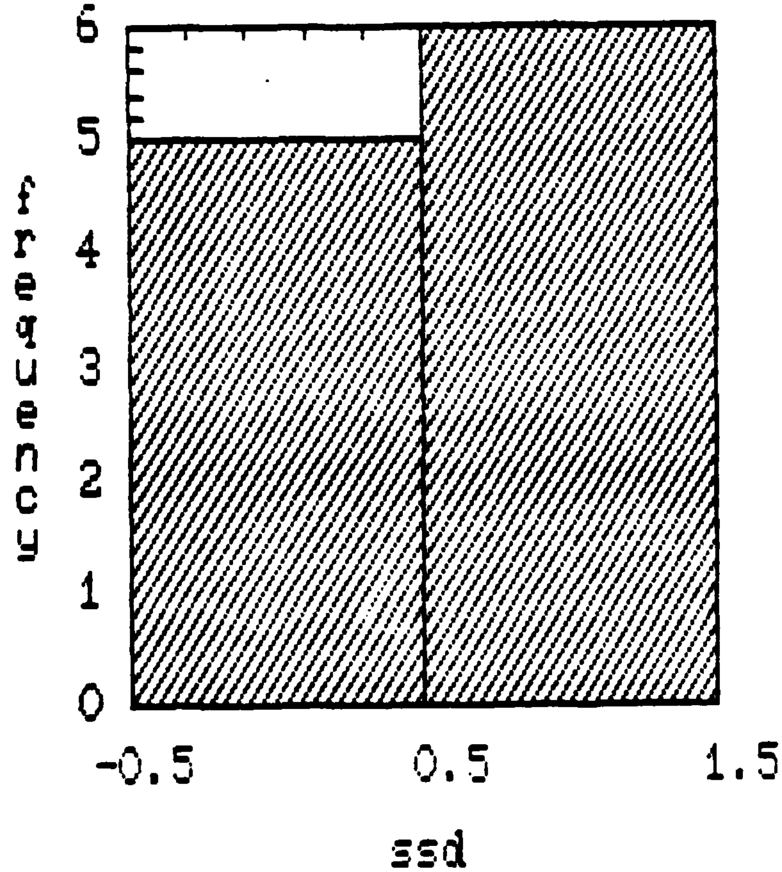
		serceil		
Sample Statistics:	Number of Obs.	25		
	Average	41018.8		
	Variance	2.23502E8		
	Std. Deviation	14950		
	Median	38820		
Confidence Interval for Mean:		95	Percent	
	Sample 1	34846.3 47191.3		24 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			
Hypothesis Test for HO: Mean = 0		Computed t statistic = 13.7187		
	vs Alt: NE	Sig. Level = 7.4607E-13		
	at Alpha = 0.05	so reject HO.		



One-Sample Analysis Results

		ssd	
Sample Statistics:	Number of Obs.	11	
	Average	0.545455	
	Variance	0.272727	
	Std. Deviation	0.522233	
	Median	1	
Confidence Interval for Mean:		95 Percent	
	Sample 1	0.19452 0.896389	10 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 3.4641	
vs Alt: NE		Sig. Level = 6.08085E-3	
at Alpha = 0.05		so reject H0.	

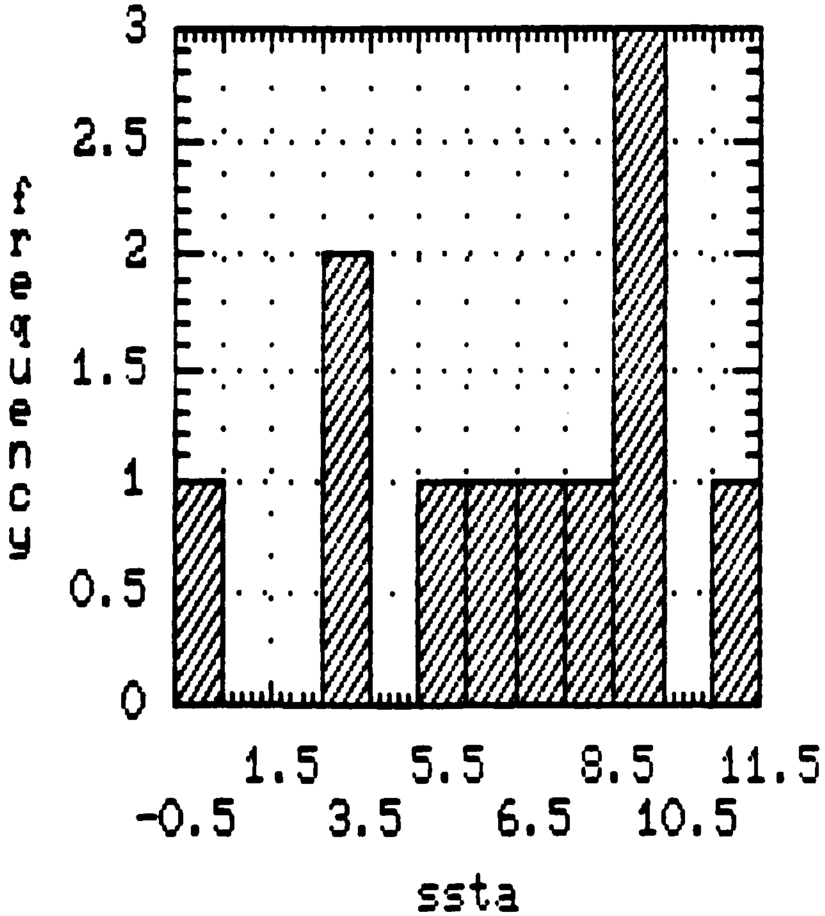
Frequency Histogram



One-Sample Analysis Results

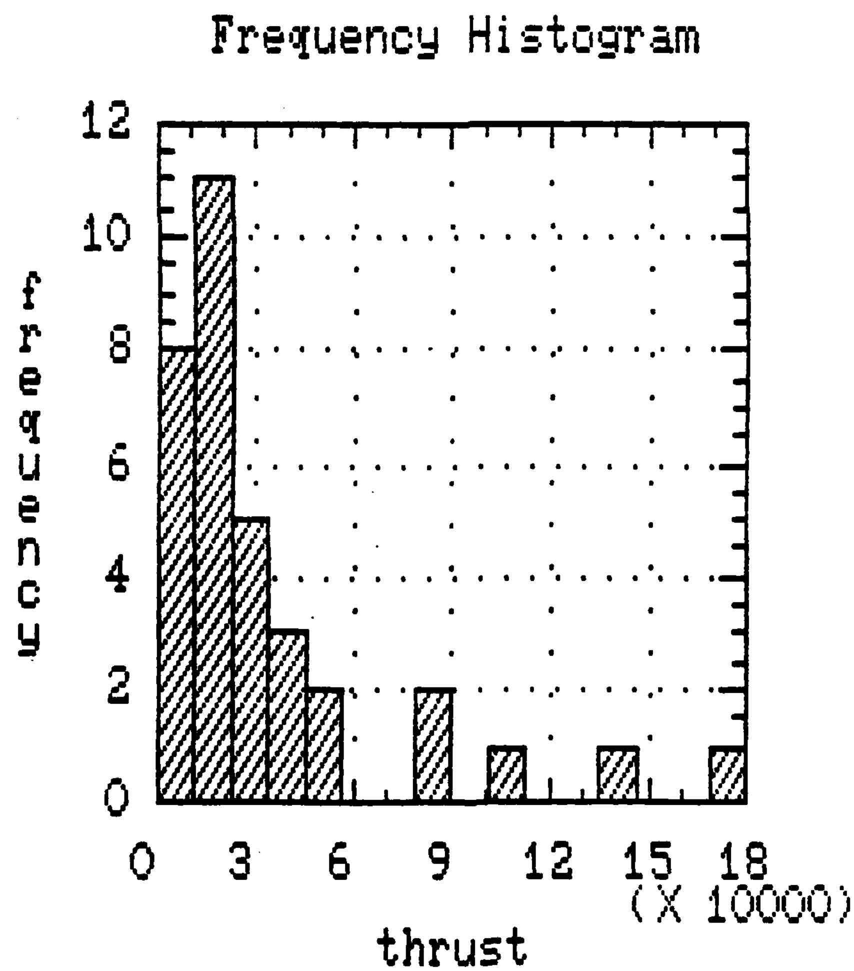
		ssta	
Sample Statistics:	Number of Obs.	11	
	Average	6.36364	
	Variance	11.0545	
	Std. Deviation .	3.32484	
	Median	7	
Confidence Interval for Mean:		95 Percent	
	Sample 1	4.12938 8.59789	10 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for HO: Mean = 0		Computed t statistic = 6.34792	
	vs Alt: NE	Sig. Level = 8.37422E-5	
	at Alpha = 0.05	so reject HO.	

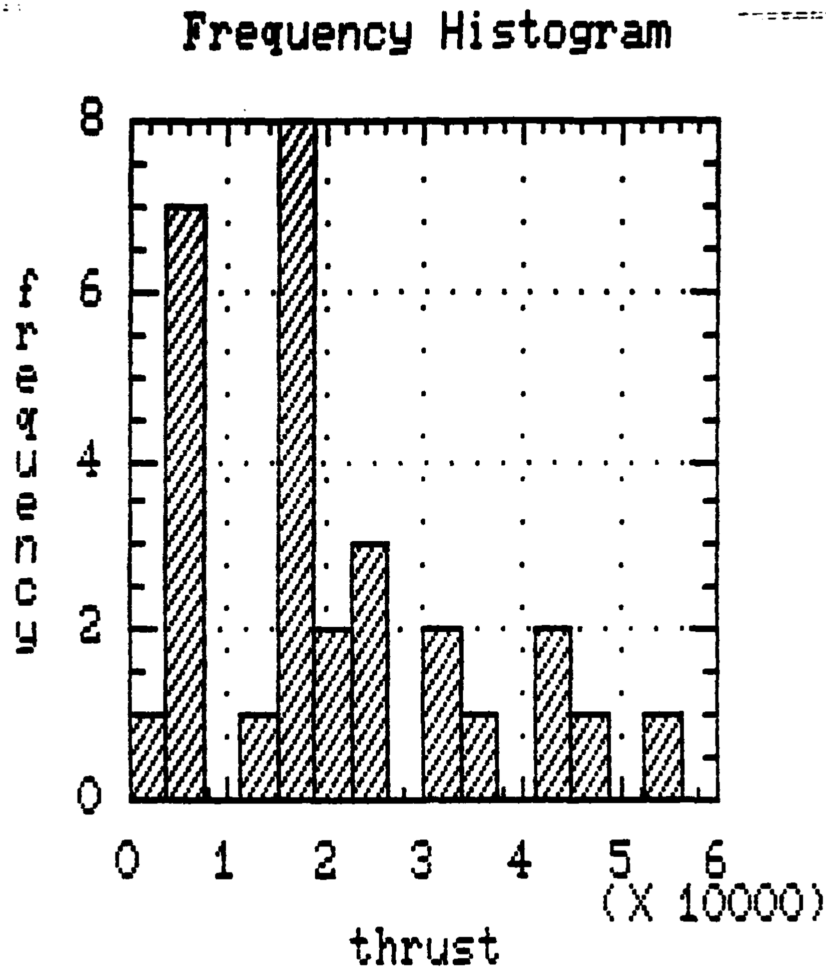
Frequency Histogram



One-Sample Analysis Results

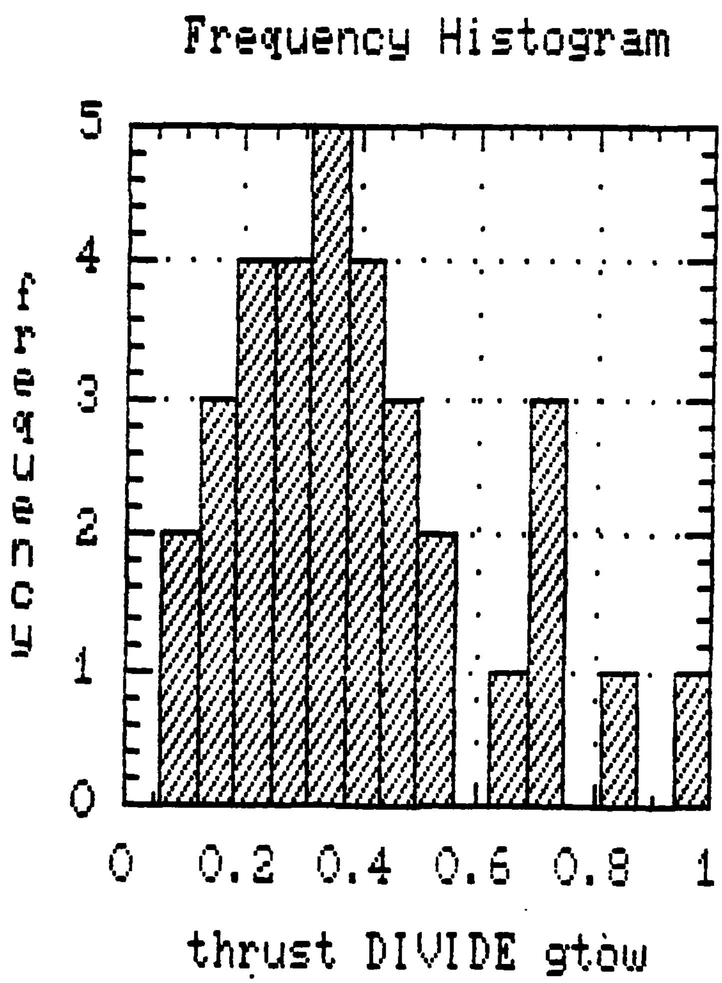
		thrust	
Sample Statistics:	**Number of Obs.**	34	
	Average	34756.5	
	Variance	1.54224E9	
	Std. Deviation	39271.4	
	Median	19415	
Confidence Interval for Mean:		95 Percent	
	Sample 1	21050.8 48462.1	33 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for HO: Mean = 0		Computed t statistic = 5.16059	
	vs Alt: NE	Sig. Level = 1.17766E-5	
	at Alpha = 0.05	so reject HO.	




Frequency Histogram
frequency
0
2
4
6
8
0
1
2
3
4
5
6
(X 10000)
thrust

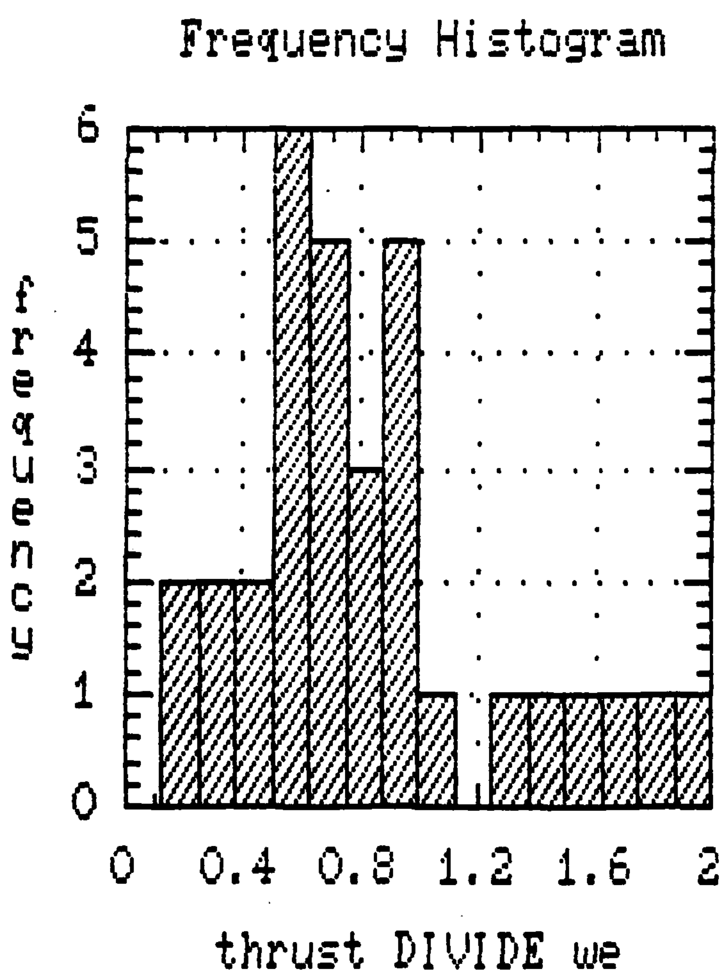
One-Sample Analysis Results

		thrust DIVIDE gtow	
Sample Statistics:	Number of Obs.	33	
	Average	0.391425	
	Variance	0.0483744	
	Std. Deviation	0.219942	
	Median	0.345	
Confidence Interval for Mean:		95 Percent	
	Sample 1	0.313419 0.469431	32 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for HO: Mean = 0		Computed t statistic = 10.2235	
	vs Alt: NE	Sig. Level = 1.31655E-11	
	at Alpha = 0.05	so reject HO.	



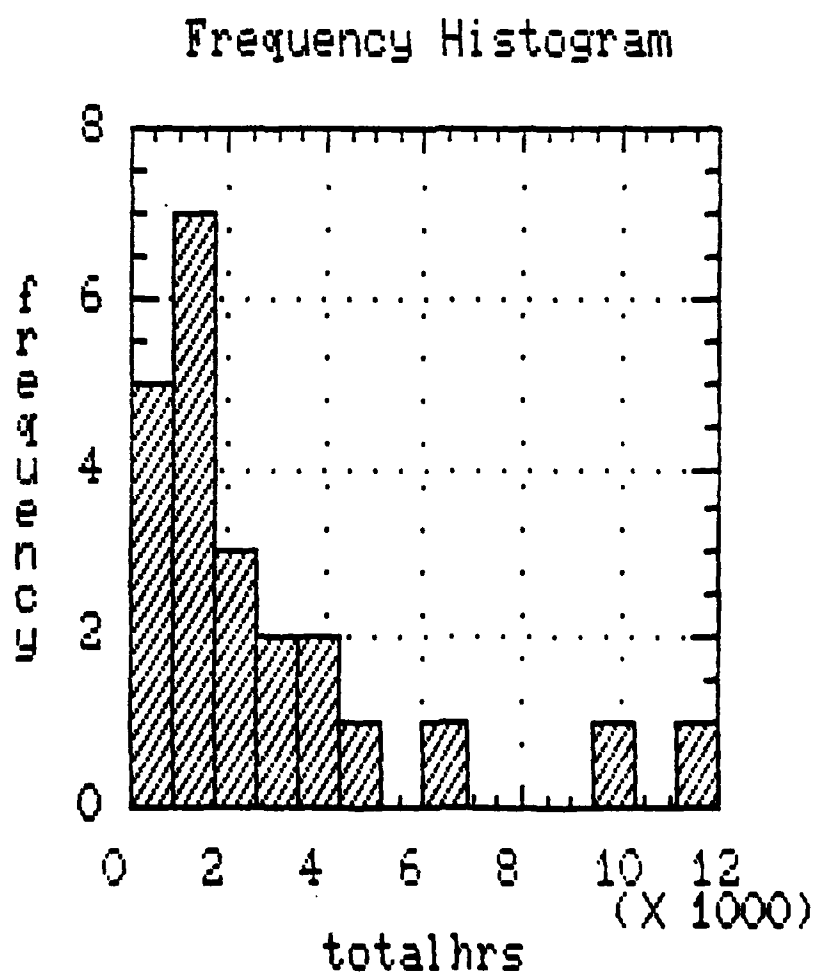
One-Sample Analysis Results

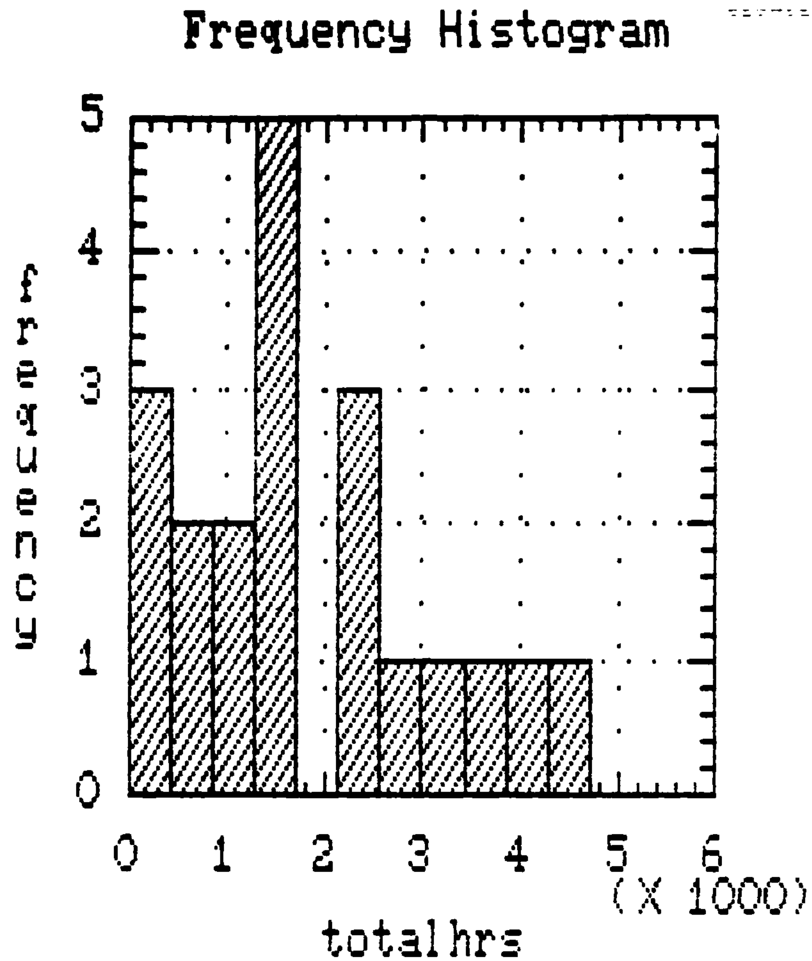
		thrust DIVIDE we	
Sample Statistics:	Number of Obs.	32	
	Average	0.826883	
	Variance	0.200047	
	Std. Deviation	0.447267	
	Median	0.703102	
Confidence Interval for Mean:		95 Percent	
	Sample 1	0.665588 0.988177	31 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for HO: Mean = 0		Computed t statistic = 10.4581	
	vs Alt: NE	Sig. Level = 1.08794E-11	
	at Alpha = 0.05	so reject HO.	



One-Sample Analysis Results

		totalhrs	
Sample Statistics:	Number of Obs.	23	
	Average	2827.24	
	Variance	8.64743E6	
	Std. Deviation	2940.65	
	Median	1555	
Confidence Interval for Mean:		95 Percent	
	Sample 1	1555.3 4099.17	22 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 4.61087	
	vs Alt: NE	Sig. Level = 1.35702E-4	
	at Alpha = 0.05	so reject H0.	

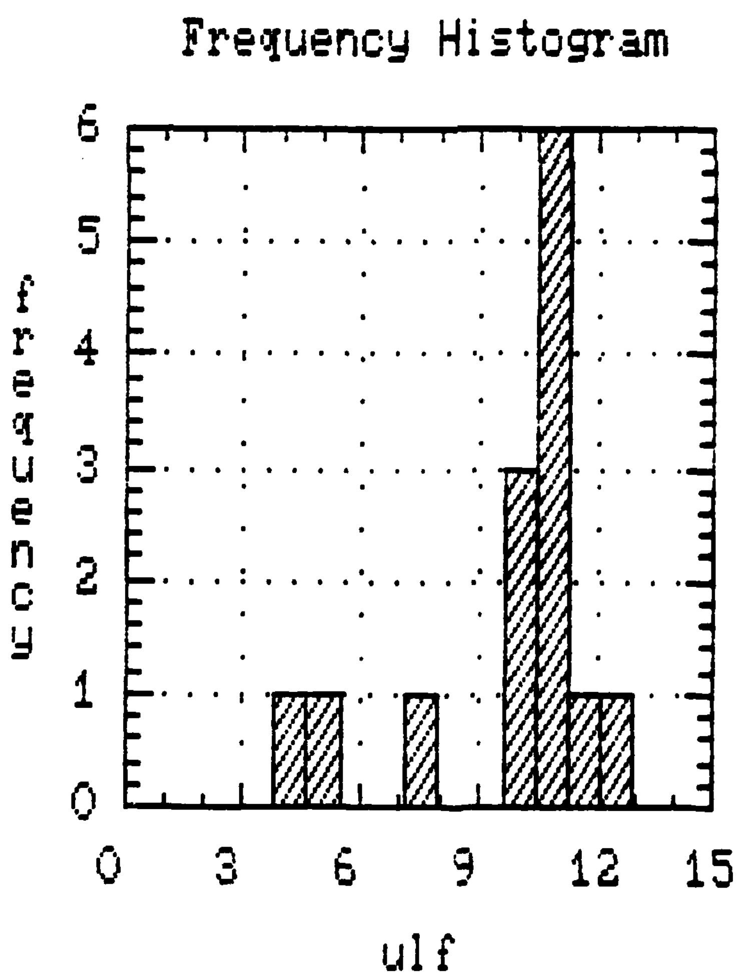




Frequency Histogram
frequency
0
1
2
3
4
5
0 1 2 3 4 5 6
(X 1000)
totalhrs

One-Sample Analysis Results

		ulf	
Sample Statistics:	Number of Obs.	14	
	Average	9.74214	
	Variance	6.3674	
	Std. Deviation	2.52337	
	Median	10.75	
Confidence Interval for Mean:		95 Percent	
	Sample 1	8.28482 11.1995	13 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 14.4457	
	vs Alt: NE	Sig. Level = 2.19436E-9	
	at Alpha = 0.05	so reject H0.	



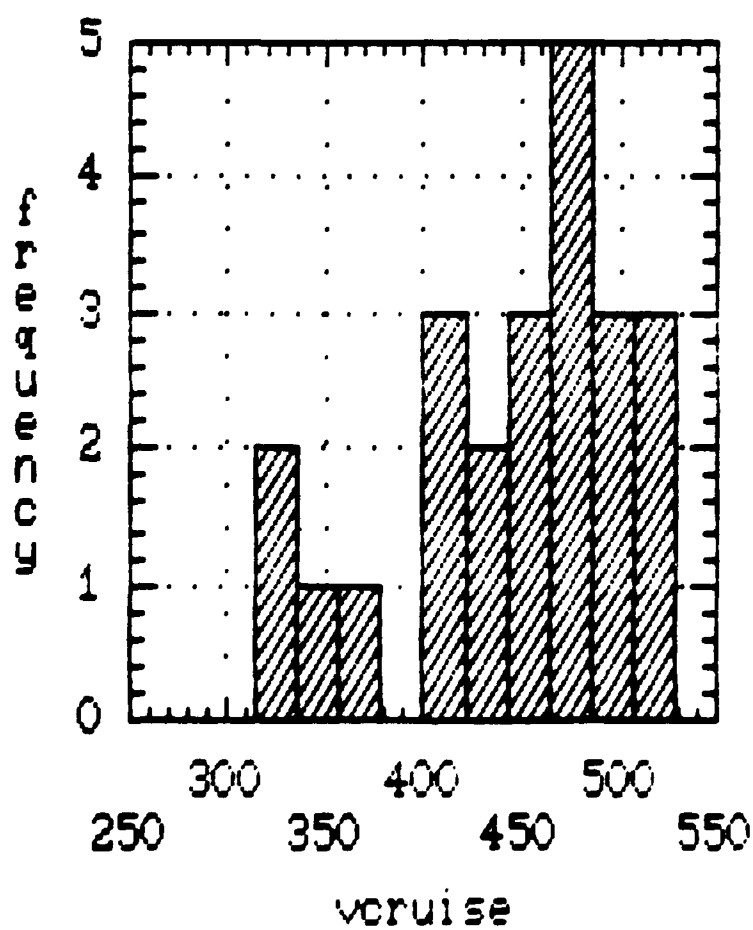
One-Sample Analysis Results

		vcruise
Sample Statistics:	Number of Obs.	24
	Average	437.542
	Variance	4698.78
	Std. Deviation	68.5477
	Median	451.5

Confidence Interval for Mean:		95	Percent	
	Sample 1	408.59	466.494	23 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			

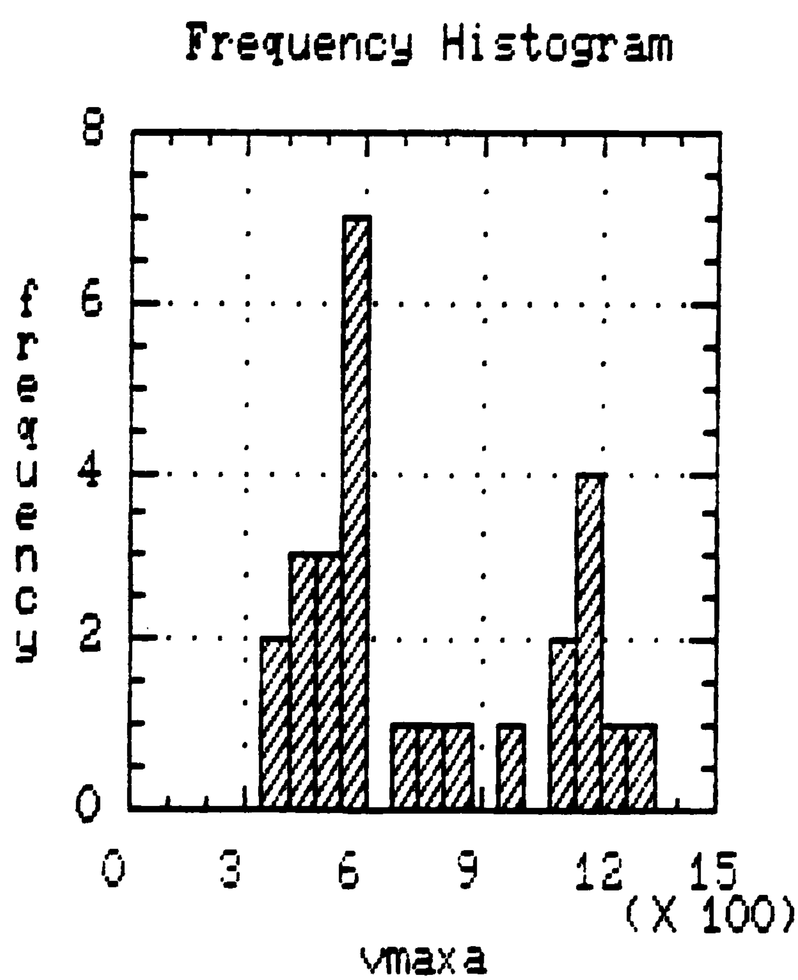
Hypothesis Test for H0: Mean = 0	Computed t statistic = 31.2703
vs Alt: NE	Sig. Level = 0
at Alpha = 0.05	so reject H0.

Frequency Histogram

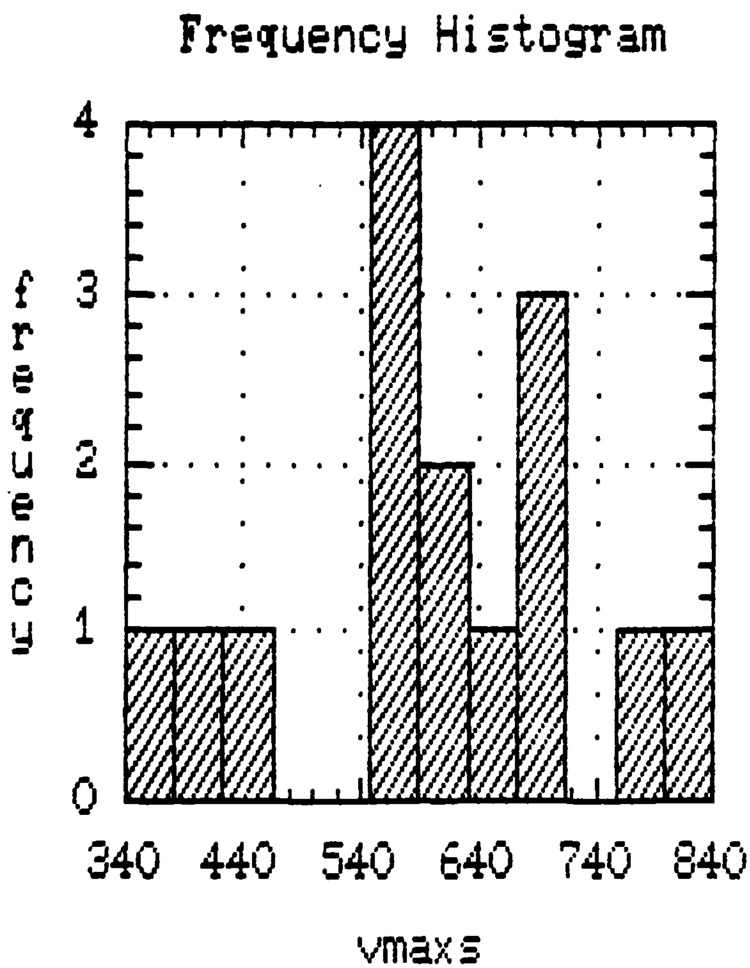


One-Sample Analysis Results

		vmaxa		
Sample Statistics:	Number of Obs.	27		
	Average	754.593		
	Variance	101210		
	Std. Deviation	318.135		
	Median	602		
Confidence Interval for Mean:		95	Percent	
	Sample 1	628.713 880.472		26 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			
Hypothesis Test for H0: Mean = 0		Computed t statistic = 12.3249		
	vs Alt: NE	Sig. Level = 2.31348E-12		
	at Alpha = 0.05	so reject H0.		



		vmaxs	
Sample Statistics:	Number of Obs.	15	
	Average	600.467	
	Variance	17782.1	
	Std. Deviation	133.35	
	Median	602	
Confidence Interval for Mean:		95 Percent	
	Sample 1	526.601 674.332	14 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 17.4395	
	vs Alt: NE	Sig. Level = 6.8257E-11	
	at Alpha = 0.05	so reject H0.	

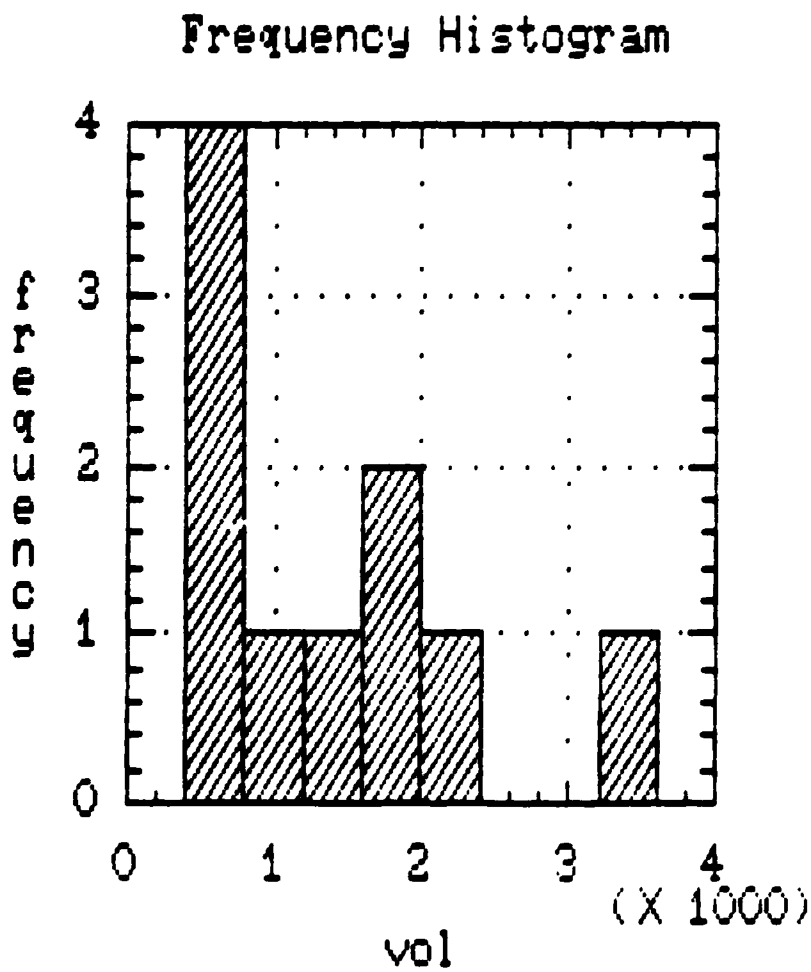


One-Sample Analysis Results

		vol
Sample Statistics:	Number of Obs.	10
	Average	1370.4
	Variance	804927
	Std. Deviation	897.177
	Median	1163.5

Confidence Interval for Mean:		95 Percent	
	Sample 1	728.423 2012.38	9 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		

Hypothesis Test for H0: Mean = 0	Computed t statistic = 4.83024
vs Alt: NE	Sig. Level = 9.33588E-4
at Alpha = 0.05	so reject H0.

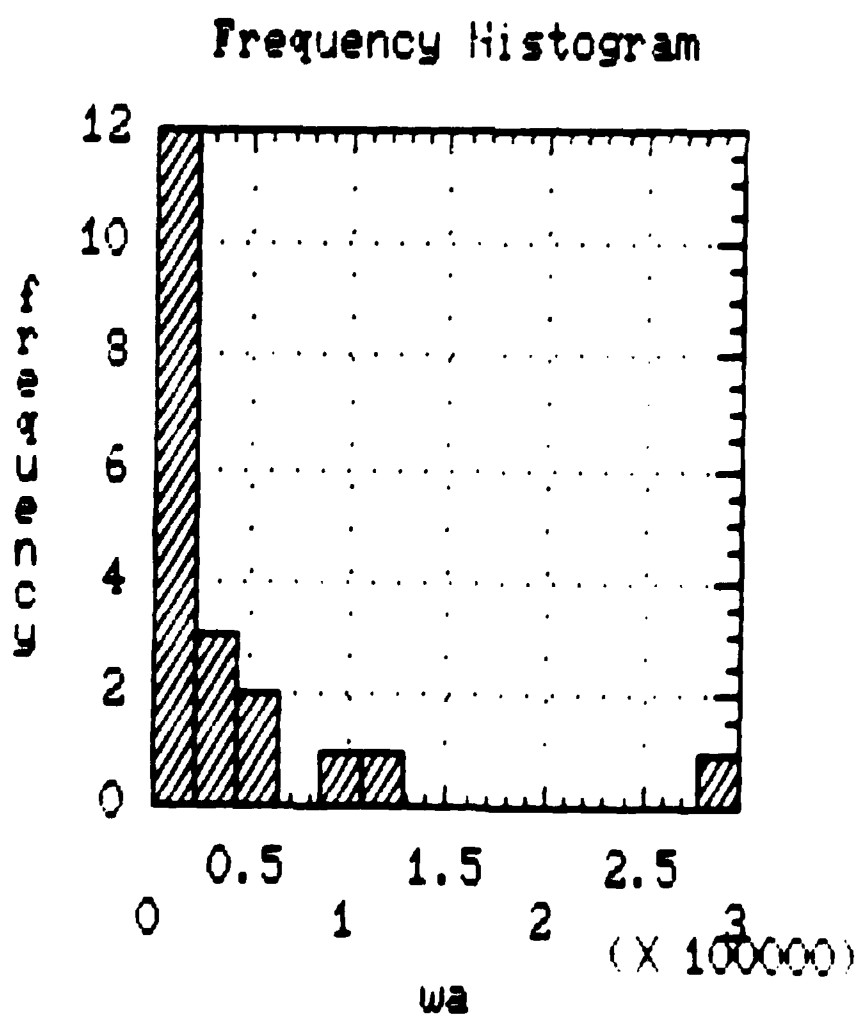


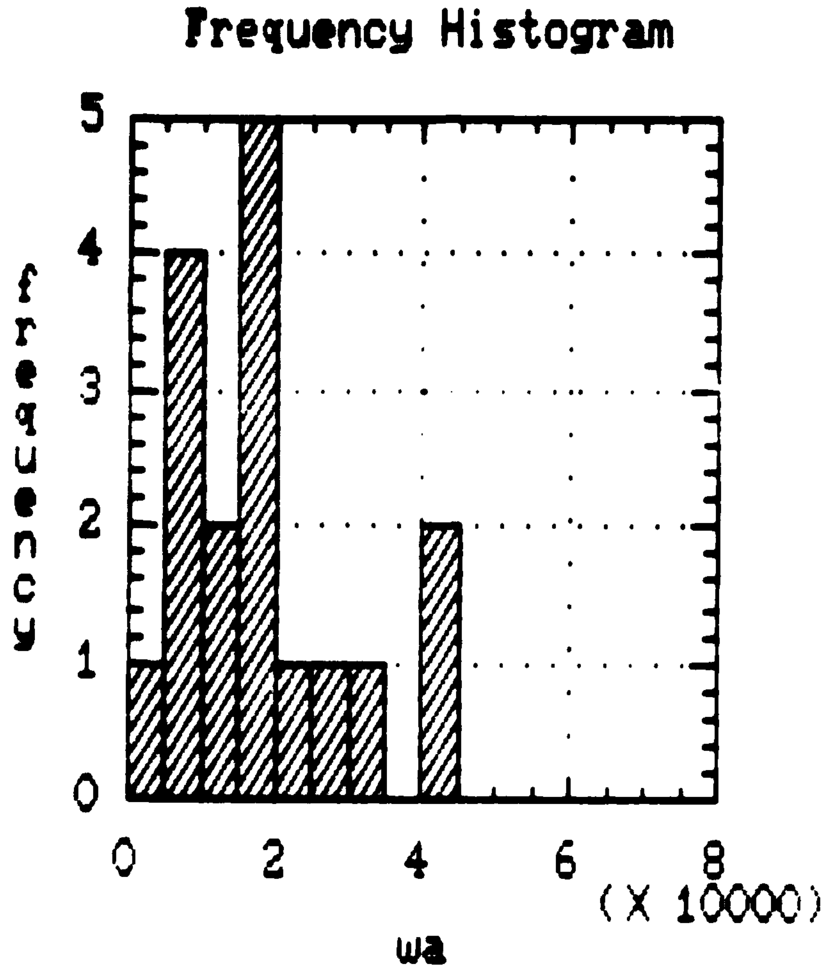
One-Sample Analysis Results

		wa
Sample Statistics:	Number of Obs.	20
	Average	41146
	Variance	4.21295E9
	Std. Deviation	64907.2
	Median	17000.5

Confidence Interval for Mean:	95 Percent	
Sample 1	10761 71530.9	19 D.F.
Confidence Interval for Variance:	0 Percent	
Sample 1		

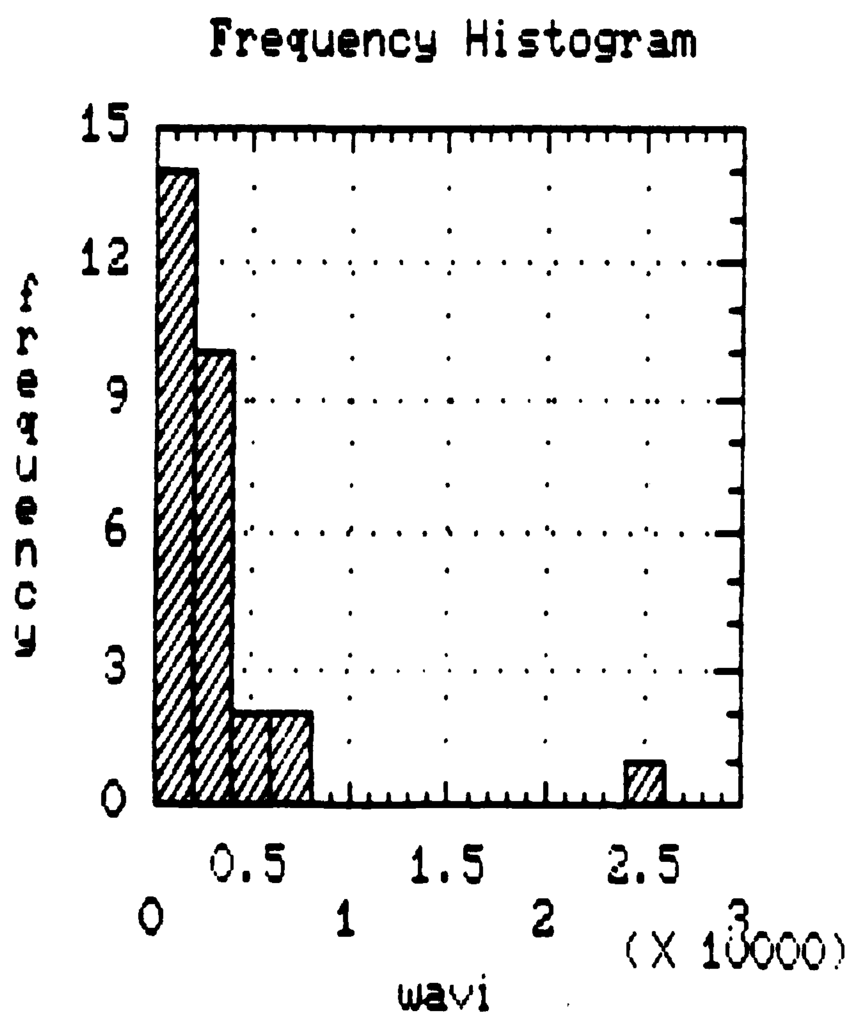
Hypothesis Test for H0: Mean = 0	Computed t statistic = 2.83497
vs Alt: NE	Sig. Level = 0.0105845
at Alpha = 0.05	so reject H0.



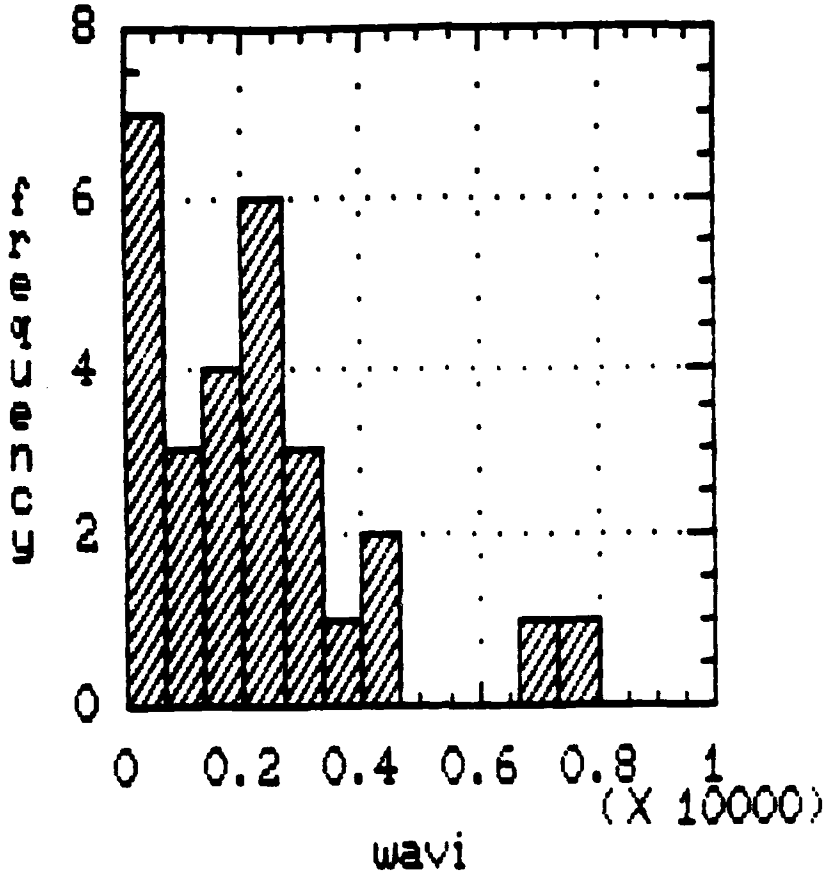

Frequency Histogram
5
4
3
2
1
0
frequency
0
2
4
6
8
(X 10000)
wa

One-Sample Analysis Results

		wavi		
Sample Statistics:	Number of Obs.	29		
	Average	2959.28		
	Variance	2.22048E7		
	Std. Deviation	4712.2		
	Median	2016		
Confidence Interval for Mean:		95	Percent	
	Sample 1	1166.43 4752.12		28 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			
Hypothesis Test for H0: Mean = 0		Computed t statistic = 3.3819		
vs Alt: NE		Sig. Level = 2.14005E-3		
at Alpha = 0.05		so reject H0.		



Frequency Histogram

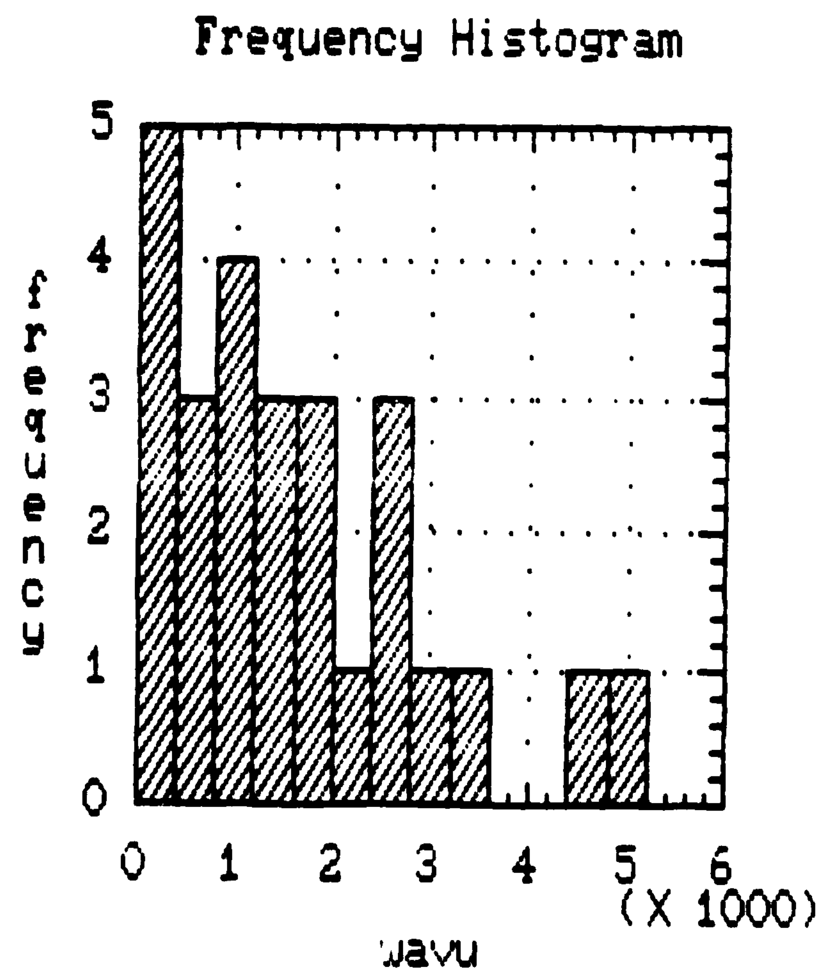


One-Sample Analysis Results

		wavu
Sample Statistics:	Number of Obs.	26
	Average	1595.23
	Variance	1.78913E6
	Std. Deviation	1337.58
	Median	1355

Confidence Interval for Mean:		95 Percent	
	Sample 1	1054.84 2135.62	25 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		

Hypothesis Test for H0: Mean = 0	Computed t statistic = 6.0812
vs Alt: NE	Sig. Level = 2.35225E-6
at Alpha = 0.05	so reject H0.



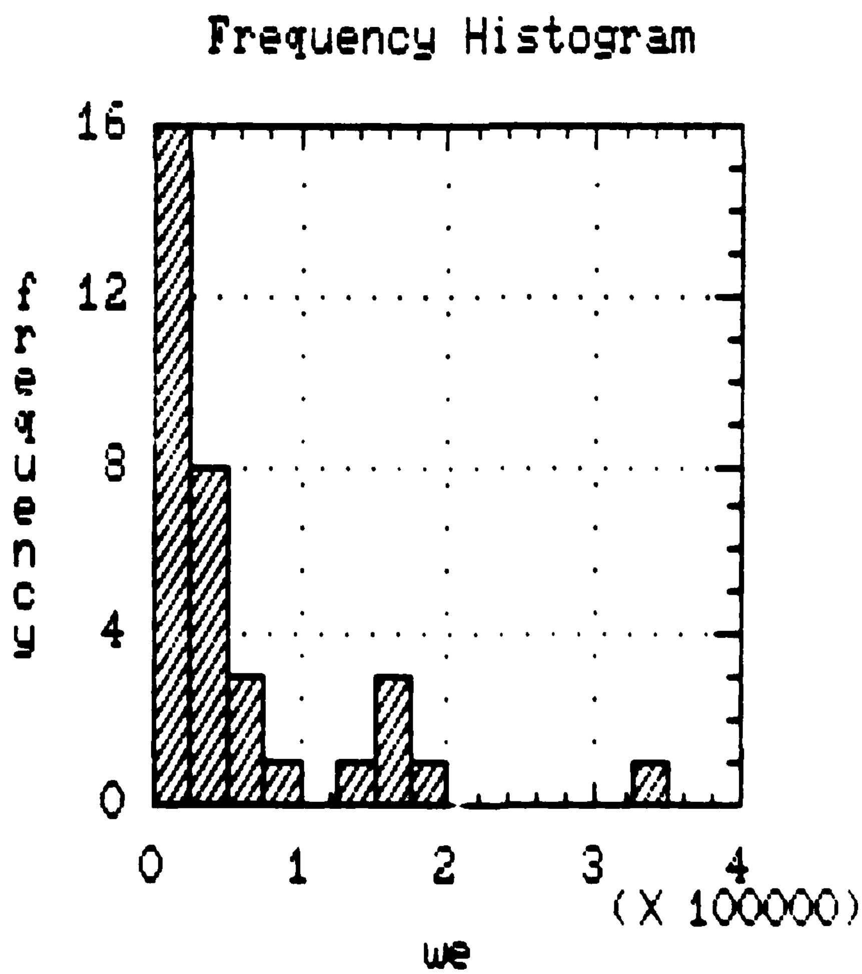
One-Sample Analysis Results

		we
Sample Statistics:	Number of Obs.	34
	Average	56357.6
	Variance	5.09945E9
	Std. Deviation	71410.4
	Median	25906

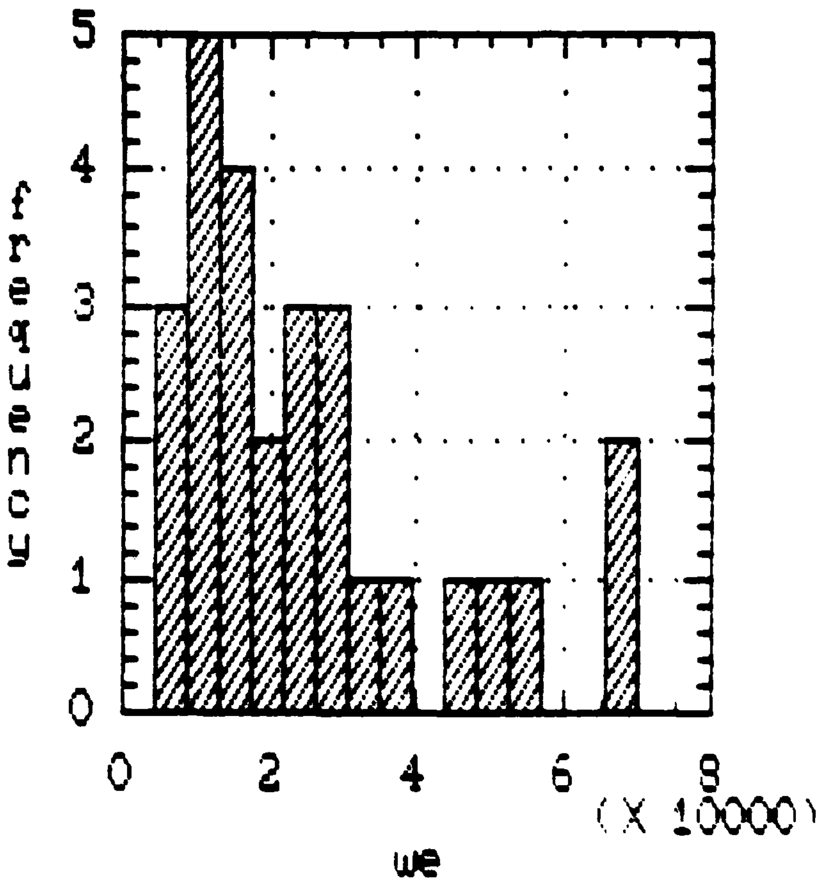
Confidence Interval for Mean: 95 Percent
Sample 1 31435.5 81279.6 33 D.F.

Confidence Interval for Variance: 0 Percent
Sample 1

Hypothesis Test for H0: Mean = 0 — Computed t statistic = 4.60182
vs Alt: NE — Sig. Level = 5.9478E-5
at Alpha = 0.05 — so reject H0.



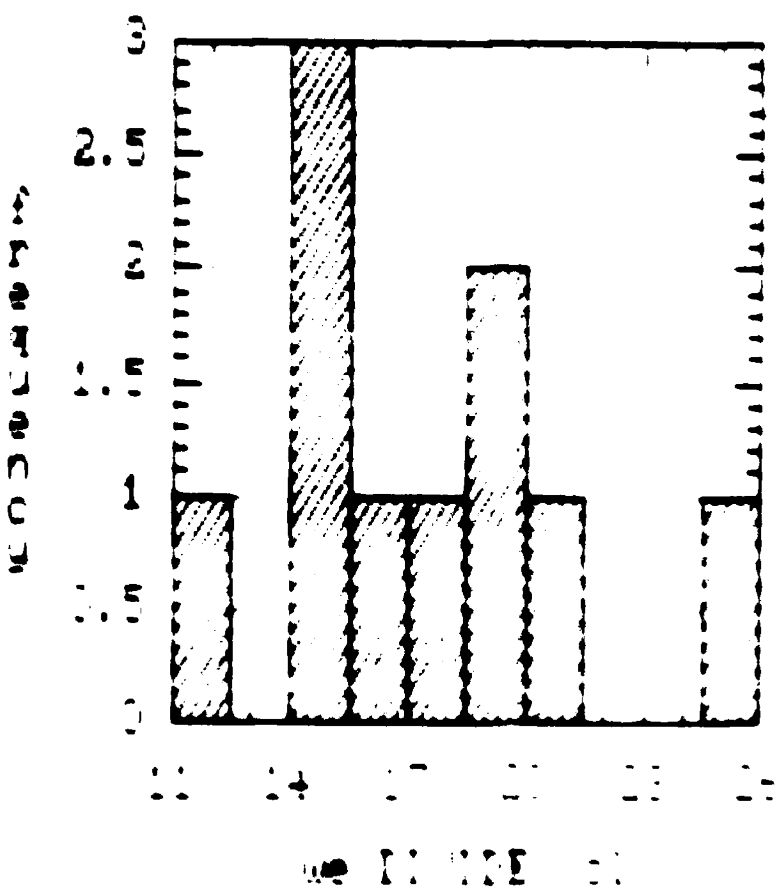
Frequency Histogram



One-Sample Analysis Results

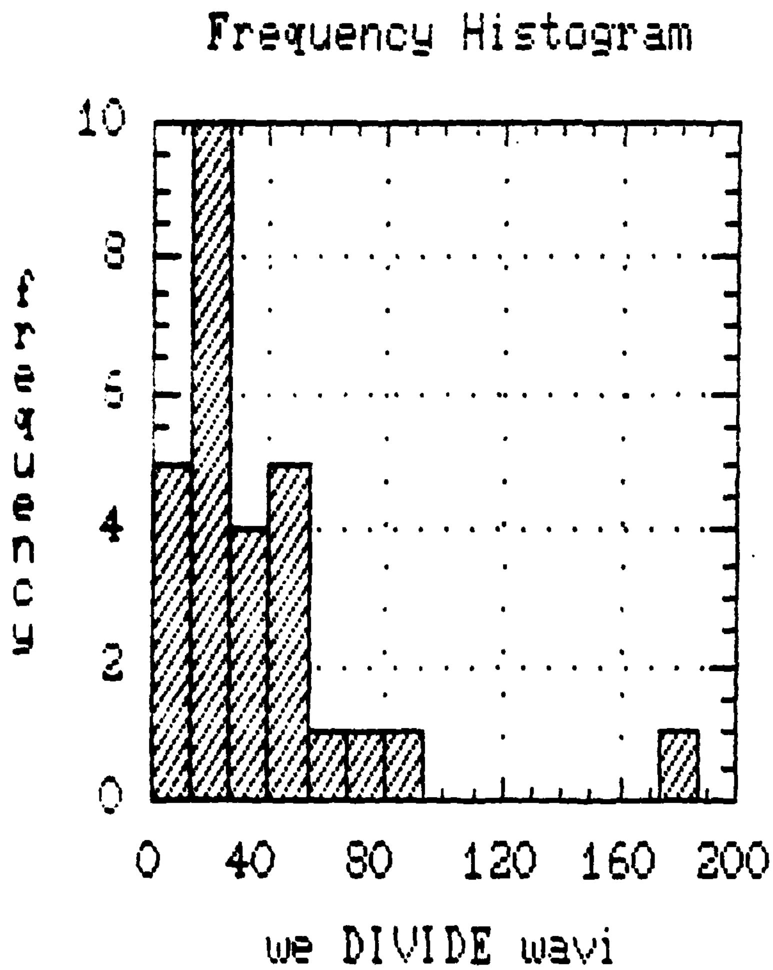
		we DIVIDE vol
Sample Statistics:	Number of Obs.	10
	Average	17.563
	Variance	17.0068
	Std. Deviation	4.12393
	Median	16.8659
Confidence Interval for Mean:		95 Percent
	Sample 1	14.6121 20.5139 [illegible] D.F.
Confidence Interval for Variance:		[illegible] Percent
	Sample 1	
Hypothesis Test for H0: Mean = [illegible]		Computed t statistic = [illegible]
	vs Alt: NE	Sig. Level = [illegible]E-[illegible]
	at Alpha = [illegible]	so reject H0.

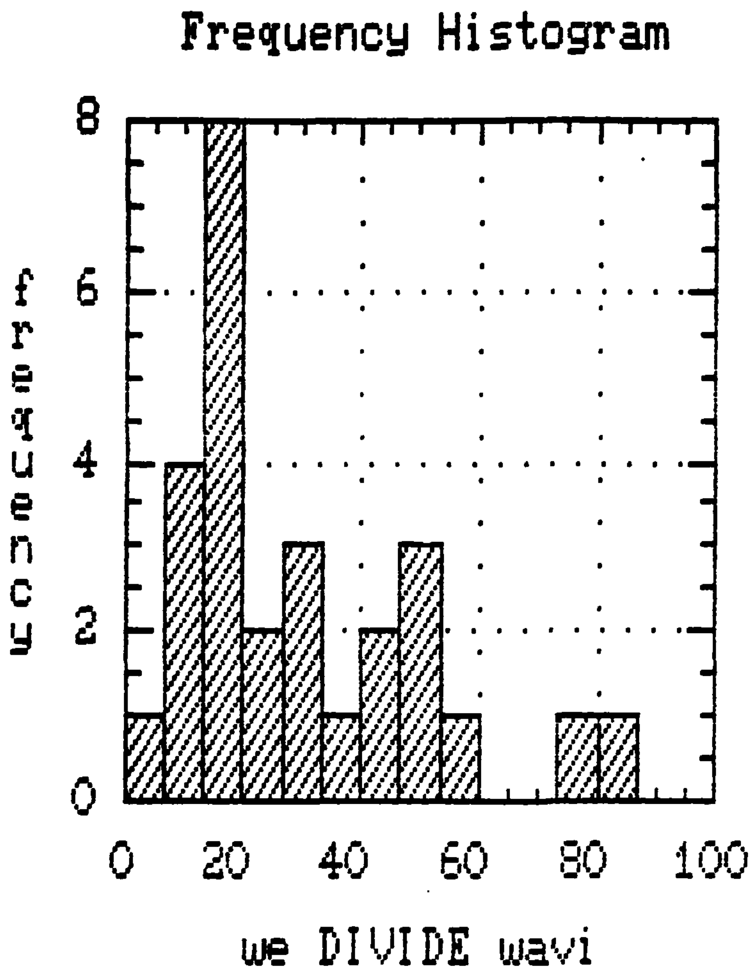
Frequency Histogram



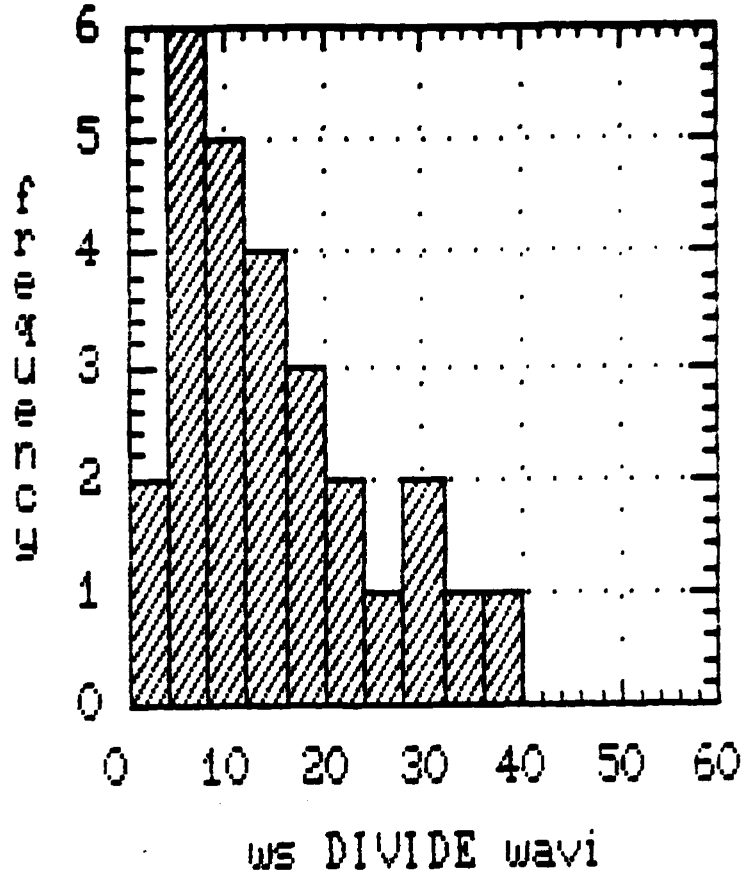
One-Sample Analysis Results

		we DIVIDE wavi
Sample Statistics:	Number of Obs.	28
	Average	35.2013
	Variance	1260.87
	Std. Deviation	35.5087
	Median	23.8228
Confidence Interval for Mean:		95 Percent
	Sample 1	21.4293 48.9734 27 D.F.
Confidence Interval for Variance:		0 Percent
	Sample 1	
Hypothesis Test for HO: Mean = 0		Computed t statistic = 5.2457
	vs Alt: NE	Sig. Level = 1.57472E-5
	at Alpha = 0.05	so reject HO.




Frequency Histogram
frequency
0
2
4
6
8
0
20
40
60
80
100
we DIVIDE wavi

Frequency Histogram



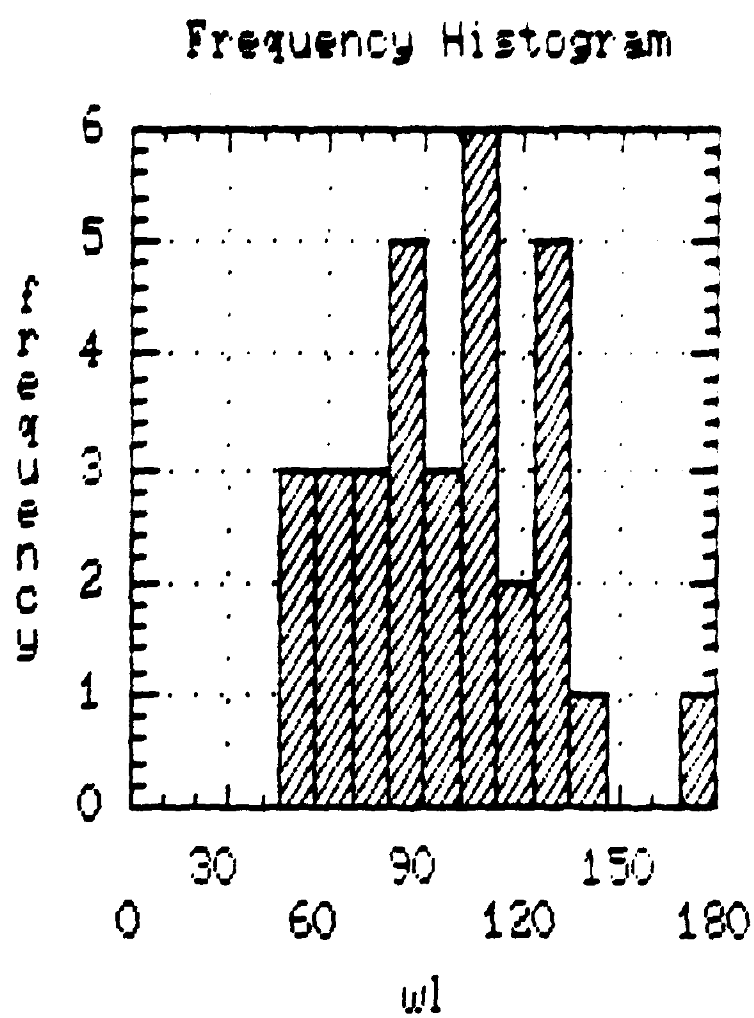
One-Sample Analysis Results

		wl
Sample Statistics:	**Number of Obs.**	**32**
	Average	**98.1719**
	Variance	**896.013**
	Std. Deviation	**29.9335**
	Median	**94.95**

Confidence Interval for Mean: 95 Percent
Sample 1 87.3772 108.967 31 D.F.

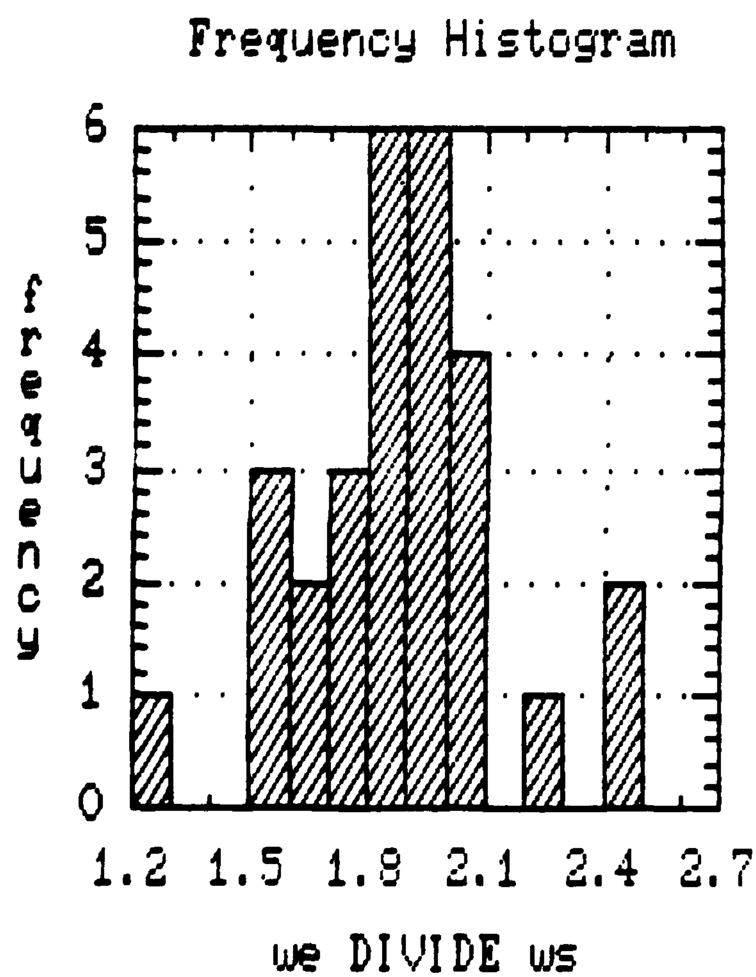
Confidence Interval for Variance: 0 Percent
Sample 1

Hypothesis Test for H0: Mean = 0 Computed t statistic = 18.5526
vs Alt: NE Sig. Level = 0
at Alpha = 0.05 so reject H0.



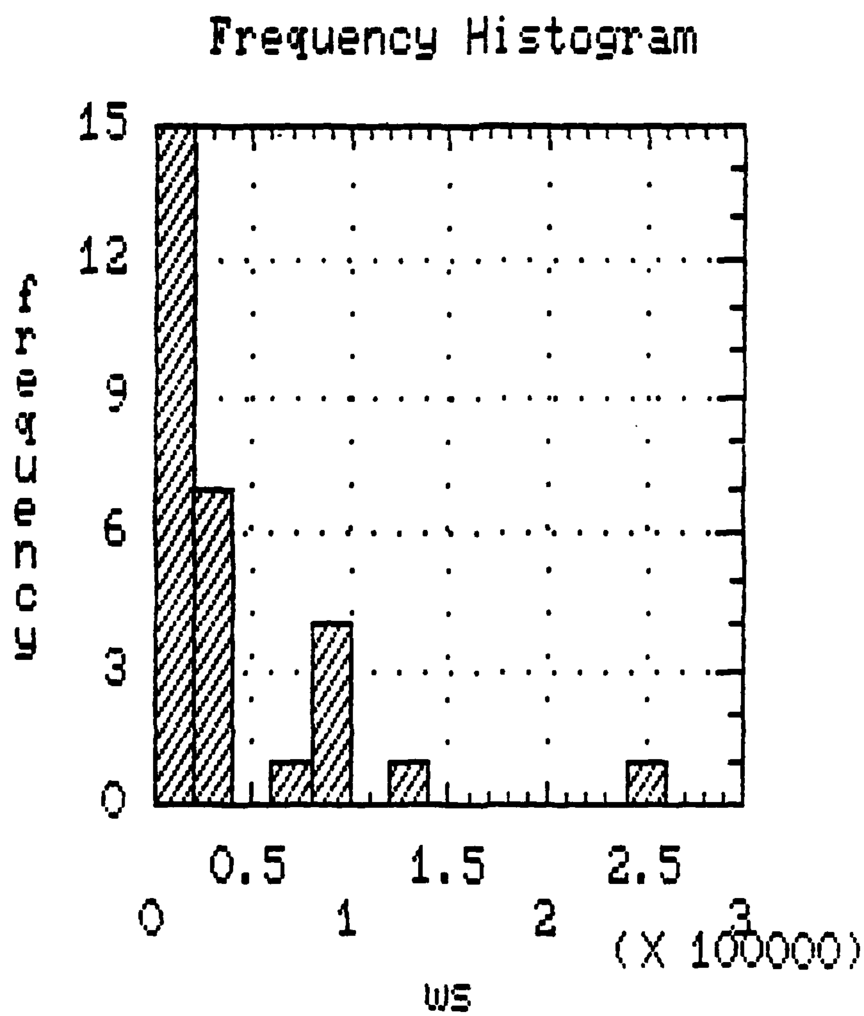
One-Sample Analysis Results

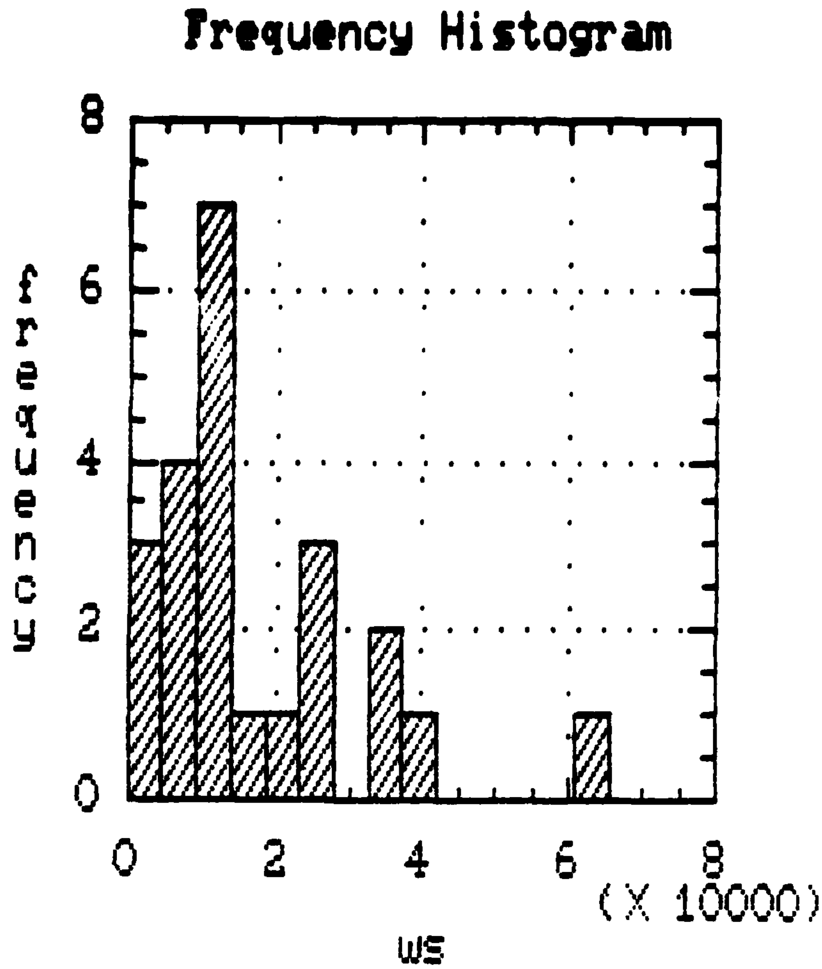
		we DIVIDE ws	
Sample Statistics:	Number of Obs.	28	
	Average	1.87446	
	Variance	0.070027	
	Std. Deviation	0.264626	
	Median	1.8928	
Confidence Interval for Mean:		95 Percent	
	Sample 1	1.77183 1.9771	27 D.F.
Confidence Interval for Variance:		0 Percent	
	Sample 1		
Hypothesis Test for H0: Mean = 0		Computed t statistic = 37.4821	
	vs Alt: NE	Sig. Level = 0	
	at Alpha = 0.05	so reject H0.	



One-Sample Analysis Results

		ws		
Sample Statistics:	Number of Obs.	29		
	Average	40255		
	Variance	2.94592E9		
	Std. Deviation	54276.3		
	Median	17801		
Confidence Interval for Mean:		95	Percent	
	Sample 1	19604.5 60905.5		28 D.F.
Confidence Interval for Variance:		0	Percent	
	Sample 1			
Hypothesis Test for H0: Mean = 0		Computed t statistic = 3.99401		
	vs Alt: NE	Sig. Level = 4.27014E-4		
	at Alpha = 0.05	so reject H0.		





Frequency Histogram
frequency
0
2
4
6
8
0
2
4
6
8
(X 10000)
ws

APPENDIX G: REGRESSION ANALYSIS

Model fitting results for: LOG totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1.644169	2.349697	-0.6997	0.4941
LOG vmaxa	1.674174	0.368939	4.5378	0.0003
LOG wsows	-2.891408	1.030646	-2.8054	0.0127

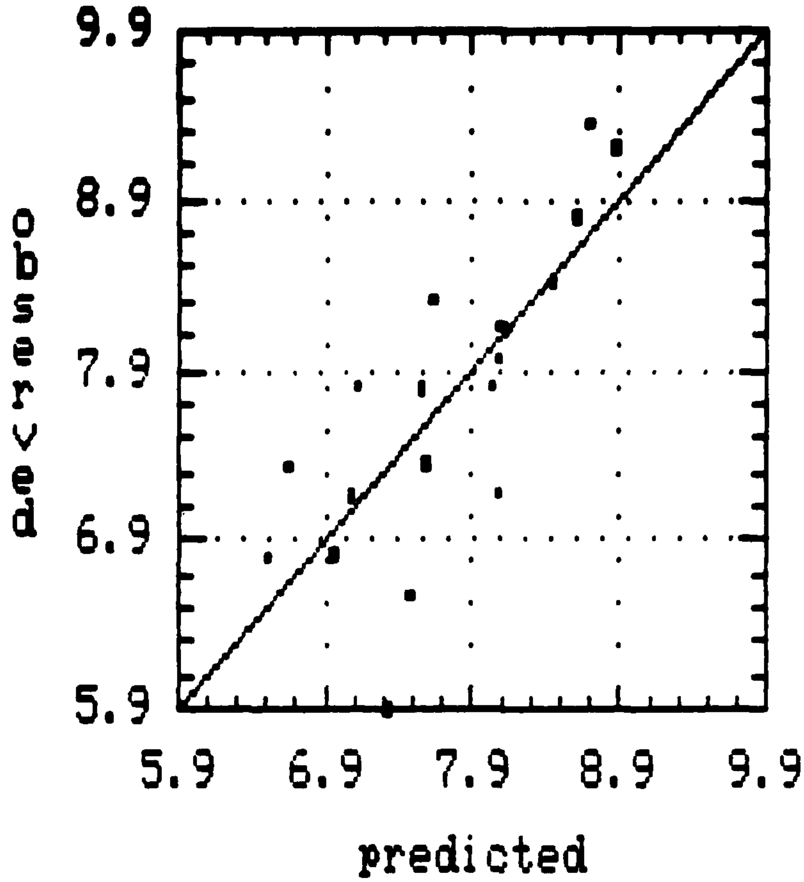
R-SQ. (ADJ.) = 0.5399 SE= 0.607238 MAE= 0.414662 DurbWat= 2.397
Previously: 0.7060 1683.511947 963.114854 2.596
19 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	8.52498	2	4.26249	11.5597	.0008
Error	5.89981	16	0.368738		
Total (Corr.)	14.4248	18			

R-squared = 0.590995 Stnd. error of est. = 0.607238
R-squared (Adj. for d.f.) = 0.53987 Durbin-Watson statistic = 2.39708

Plot of LOG totalhrs



Stepwise Selection for LOG totalhrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 2	F-to-remove: 4.00

R-squared: .95175 Adjusted: .93797 MSE: 0.0316714 d.f.: 7

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. LOG ws	0.98550	88.4172	2. LOG we	.0818	.0404
7. LOG vmaxs	1.46814	34.1405	3. LOG weows	.0978	.0580
			4. LOG vmaxa	.1065	.0688
			5. LOG vcruise	.2166	.2954
			6. LOG gtow	.1600	.1577
			8. LOG gtowows	.1601	.1577

Model fitting results for: LOG totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-10.899863	1.781637	-6.1179	0.0005
LOG ws	0.985498	0.104806	9.4030	0.0000
LOG vmaxs	1.468145	0.251266	5.8430	0.0006

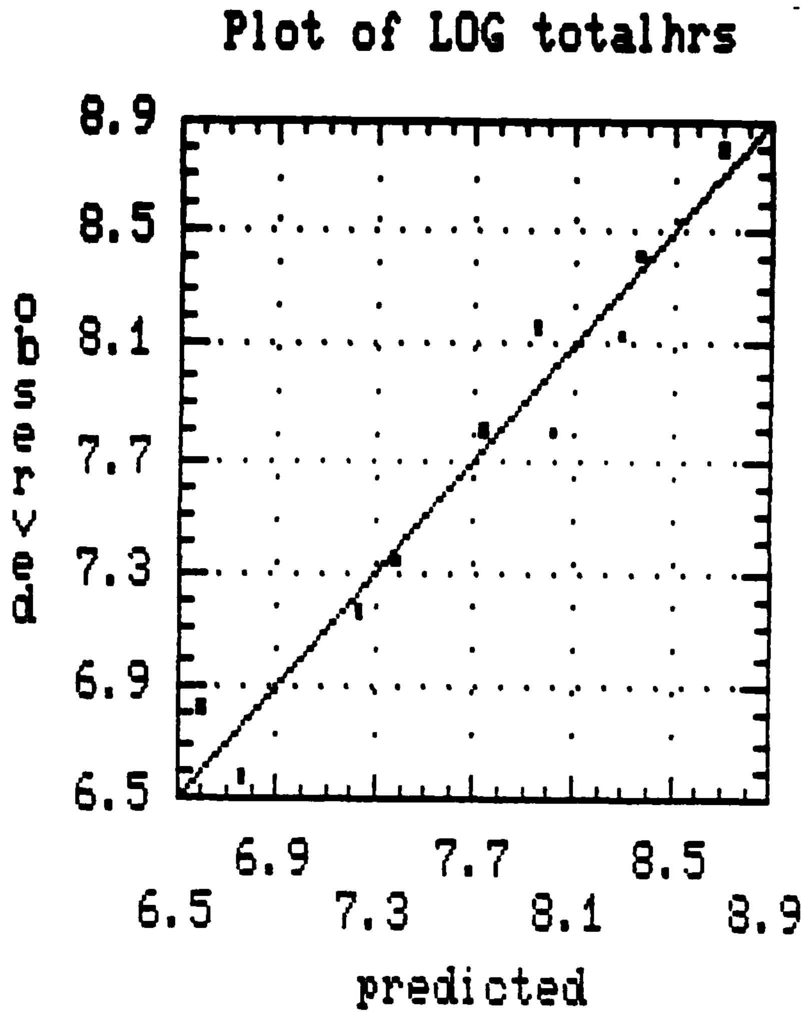
R-SQ. (ADJ.) = 0.9380	SE=	0.177965	MAE=	0.132311	DurbWat=	2.029
Previously: 0.9380		0.177965		0.132311		2.029

10 observations fitted, forecast(s) computed for 3 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	4.37345	2	2.18672	69.0440	.0000
Error	0.221700	7	0.0316714		
Total (Corr.)	4.59515	9			

R-squared = 0.951753 Stnd. error of est. = 0.177965
R-squared (Adj. for d.f.) = 0.937969 Durbin-Watson statistic = 2.02894



Plot of LOG totalhrs
8.9
8.5
8.1
7.7
7.3
6.9
6.5
observed
6.9
7.7
8.5
6.5
7.3
8.1
8.9
predicted

Model fitting results for: LOG totalhrs

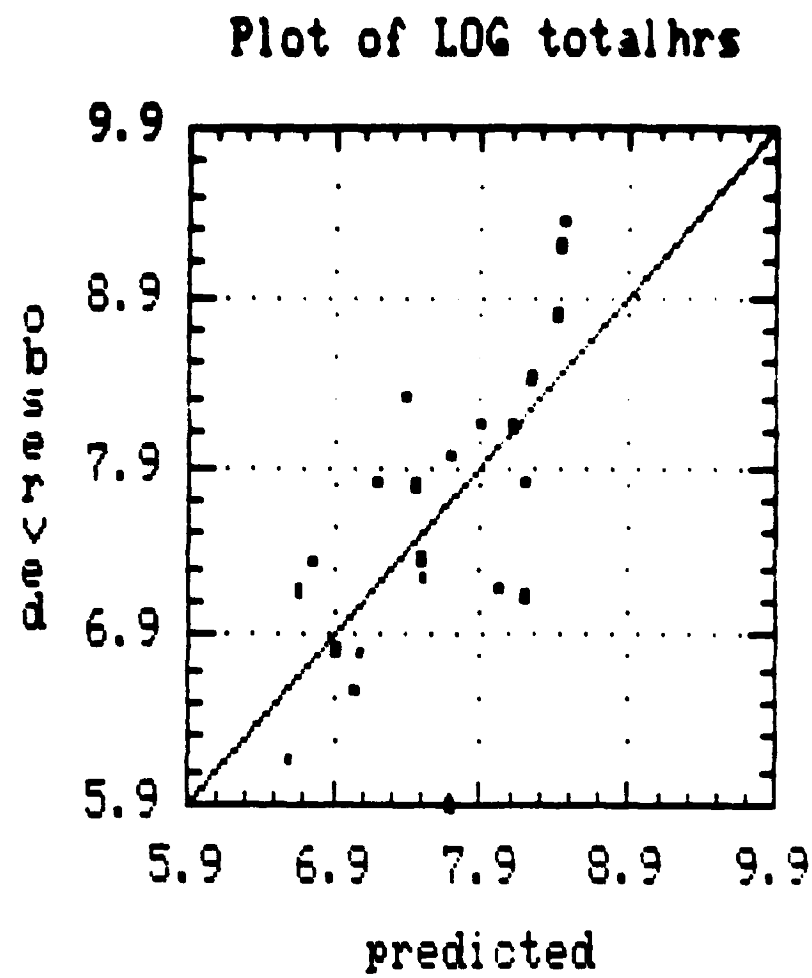
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-4.78732	3.188752	-1.5013	0.1497
LOG gtow	0.272277	0.142315	1.9132	0.0709
LOG vmaxa	1.415453	0.385744	3.6694	0.0016

R-SQ. (ADJ.) = 0.3906 SE= 0.704933 MAE= 0.523254 DurbWat= 2.408
Previously: 0.0000 0.000000 0.000000 0.000
22 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	7.68378	2	3.84189	7.73125	.0035
Error	9.44168	19	0.496931		
Total (Corr.)	17.1255	21			

R-squared = 0.448676 Stnd. error of est. = 0.704933
R-squared (Adj. for d.f.) = 0.390642 Durbin-Watson statistic = 2.40754


Plot of LOG totalhrs
9.9
8.9
7.9
6.9
5.9
observed
5.9
6.9
7.9
8.9
9.9
predicted

Model fitting results for: LOG [illegible]

Independent variable	coefficient	std. error	t-value	sig. level
CONSTANT	-4.[illegible]	3.457228	[illegible]	[illegible]
LOG [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LOG [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LOG [illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

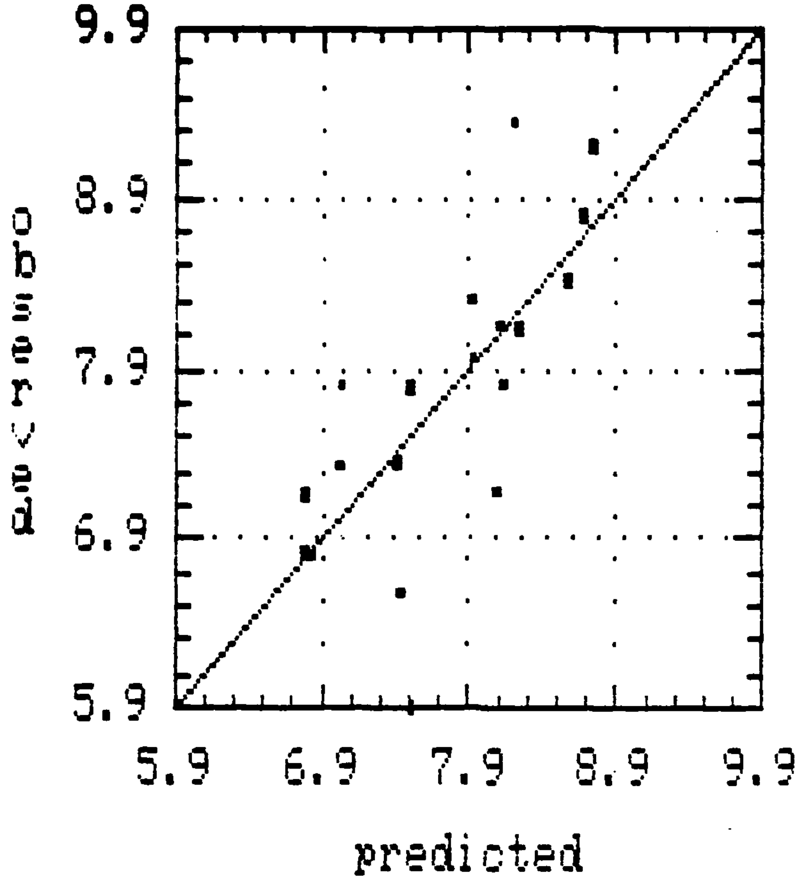
Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	7.51159	3	2.50386	5.43279	[illegible]
Error	6.91320	15	0.460880		
Total (Corr.)	14.4248	18			

R-squared = 0.520742
R-squared (Adj. for d.f.) = 0.42489

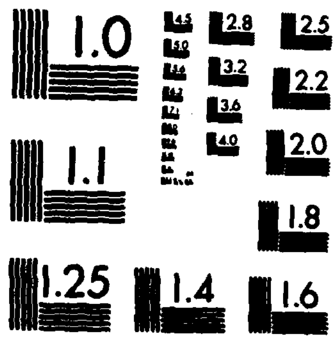
Stnd. error of est. = 0.678881
Durbin-Watson statistic = 2.34636

Plot of LOG totalhrs



AD-A181 466 COST ANALYSIS FOR AIRCRAFT SYSTEM TEST AND EVALUATION: EMPIRICAL SURVEY D..(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA W J FOSTER ET AL. MAR 87 3/3

UNCLASSIFIED F/G 5/3 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Model fitting results for: LOG totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-84.270745	28.941247	-2.9118	0.0141
LOG ws	-4.975196	2.265801	-2.1958	0.0505
LOG we	63.286114	20.602163	3.0718	0.0106
LOG we DIVIDE LOG ws	-64.565417	21.422902	-3.0139	0.0118
LOG vcruise	1.176559	0.947667	1.2415	0.2402

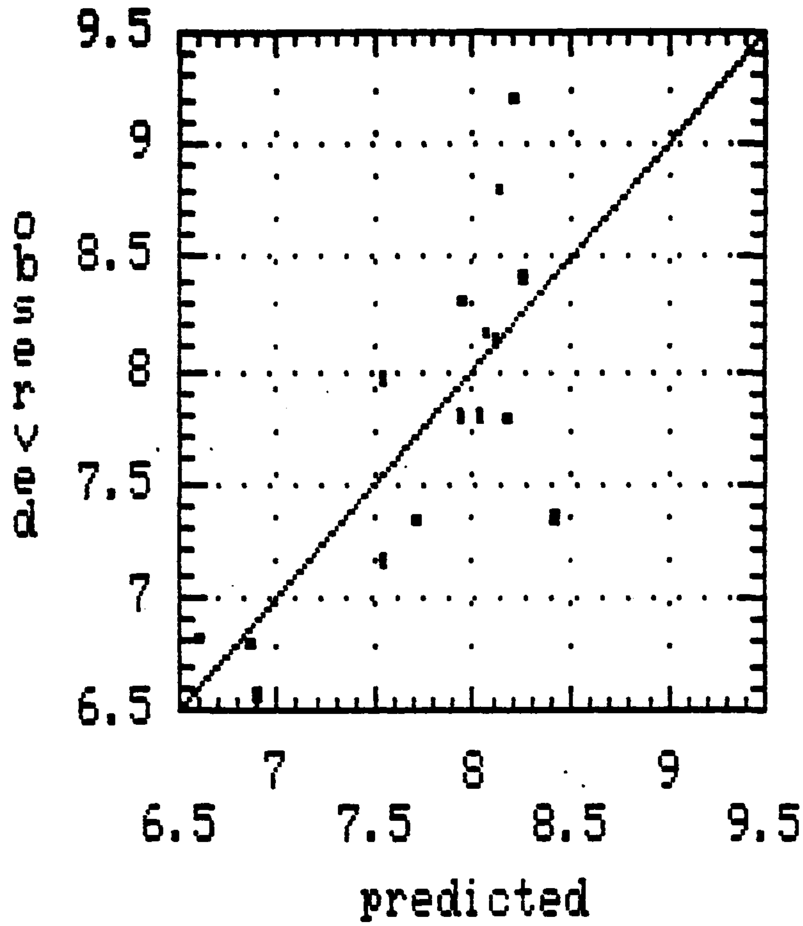
R-SQ. (ADJ.) = 0.3979 SE= 0.571264 MAE= 0.368527 DurbWat= 1.101
Previously: 0.0000 0.000000 0.000000 0.000
16 observations fitted, forecast(s) computed for 4 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	4.54038	4	1.13509	3.47823	.0454
Error	3.58976	11	0.326342		
Total (Corr.)	8.13014	15			

R-squared = 0.558462 Stnd. error of est. = 0.571264
R-squared (Adj. for d.f.) = 0.397903 Durbin-Watson statistic = 1.10092

Plot of LOG totalhrs



Model fitting results for: LOG totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-5.024162	3.147581	-1.5962	0.1269
LOG we	0.318161	0.154253	2.0626	0.0531
LOG vmaxa	1.411488	0.380101	3.7135	0.0015

R-SQ. (ADJ.) = 0.4062	SE=	0.695872	MAE=	0.499345	DurbWat=	2.481
Previously: 0.0000		0.000000		0.000000		0.000

22 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

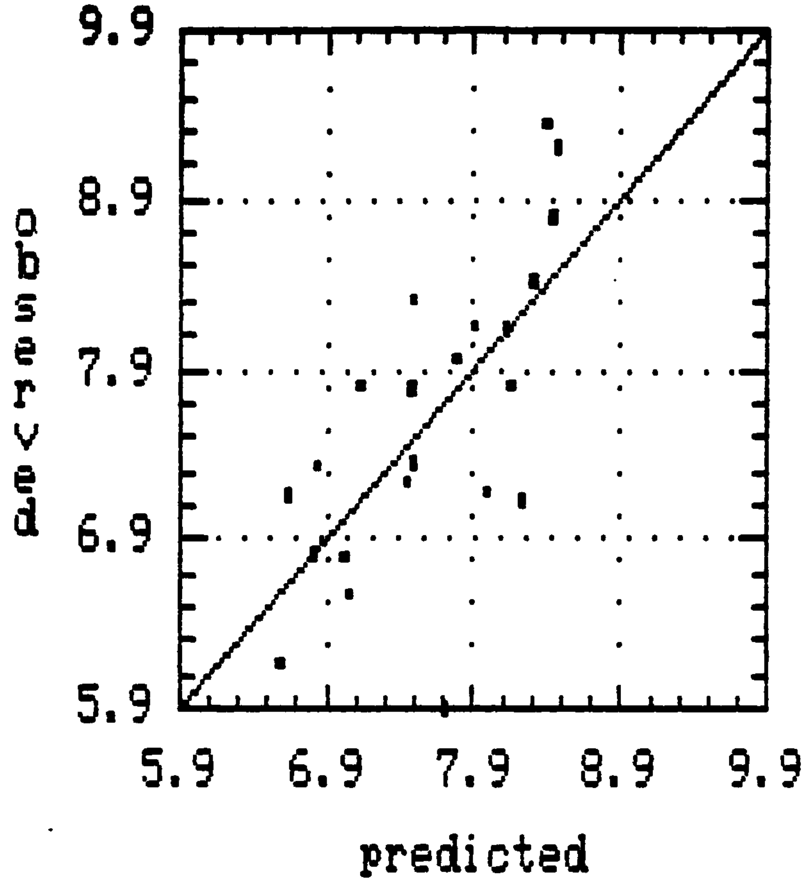
Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	7.92494	2	3.96247	8.18290	.0027
Error	9.20052	19	0.484238		
Total (Corr.)	17.1255	21			

R-squared = 0.462758 Stnd. error of est. = 0.695872

R-squared (Adj. for d.f.) = 0.406206 Durbin-Watson statistic = 2.48074

Plot of LOG totalhrs



Model fitting results for: totalhrs

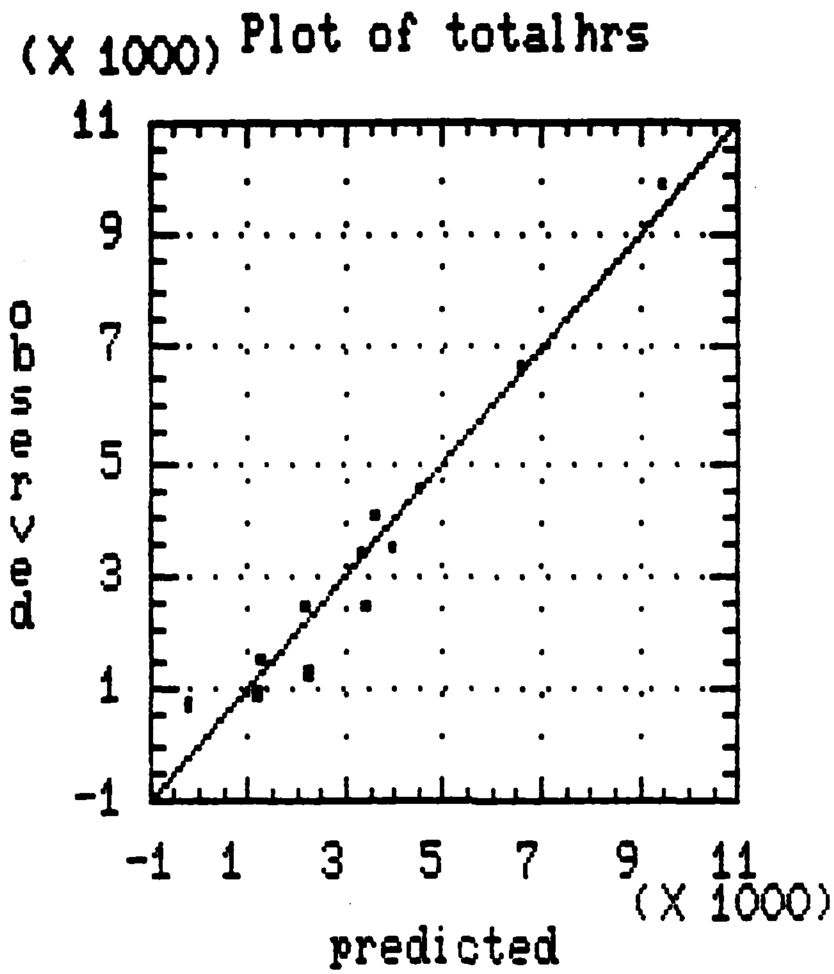
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-6726.836552	1012.435443	-6.6442	0.0003
vmaxa	2.330642	0.87699	2.6575	0.0326
wl	35.224491	10.321967	3.4126	0.0112
ws DIVIDE wavi	97.288109	23.353698	4.1659	0.0042
we	0.132533	0.037022	3.5799	0.0090

R-SQ. (ADJ.) = 0.9280 SE= 712.704726 MAE= 436.237562 DurbWat= 0.892
Previously: 0.0000 0.000000 0.000000 0.000
12 observations fitted, forecast(s) computed for 10 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	74004804.	4	18501201.	36.4234	.0001
Error	3555636.	7	507948.		
Total (Corr.)	77560440.	11			

R-squared = 0.954157 Stnd. error of est. = 712.705
R-squared (Adj. for d.f.) = 0.92796 Durbin-Watson statistic = 0.892229



(X 1000) Plot of totalhrs
11
9
7
5
3
1
-1
observed
-1 1 3 5 7 9 11
(X 1000)
predicted

Stepwise Selection for totalhrs

Selection: Backward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 3	F-to-remove: 4.00

R-squared: .94437 Adjusted: .90728 MSE: 973045 d.f.: 9

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	8.14256	83.3816	7. cq	.2576	.5684
2. ws DIVIDE wavi	194.380	20.6772	8. ff RAISE 3	.2691	.6243
3. wavu	2.33100	28.8253	9. serceil	.0949	.0727
4. gtow	-0.02500	42.1519			
5. weows	-13021.5	46.2526			
6. gtowows	909.081	8.3928			

Model fitting results for: totalhrs

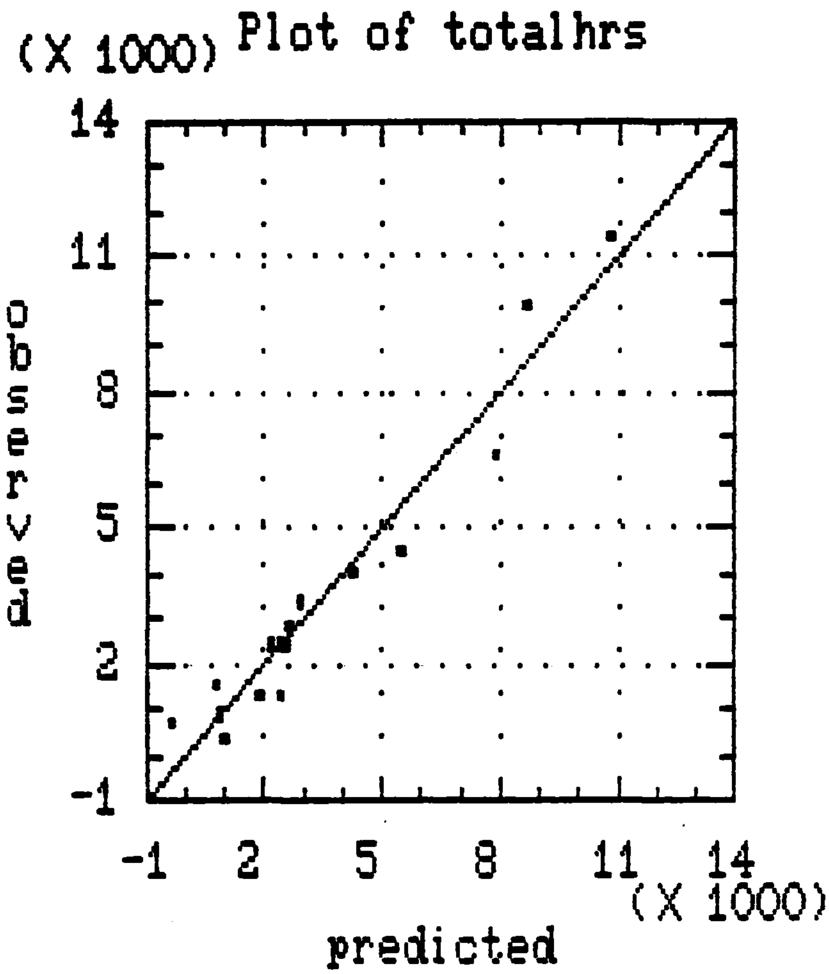
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	12749.531908	4000.619381	3.1869	0.0111
vmaxa	8.142559	0.891715	9.1314	0.0000
ws DIVIDE wavi	194.379668	42.746922	4.5472	0.0014
wavu	2.331001	0.434166	5.3689	0.0005
gtow	-0.025003	0.003851	-6.4924	0.0001
weows	-1.302149E4	1914.664197	-6.8009	0.0001
gtowows	909.080784	313.797035	2.8970	0.0177

R-SQ. (ADJ.) = 0.9073 SE= 986.430249 MAE= 609.756674 DurbWat= 2.240
Previously: 0.6783 1760.963833 1067.911642 2.201
16 observations fitted, forecast(s) computed for 2 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	148657177.	6	24776196.	25.4625	.0000
Error	8757402.	9	973045.		
Total (Corr.)	157414578.	15			

R-squared = 0.944367 Stnd. error of est. = 986.43
R-squared (Adj. for d.f.) = 0.907279 Durbin-Watson statistic = 2.24001


(X 1000) Plot of totalhrs
14
11
8
5
2
-1
observed
-1 2 5 8 11 14
(X 1000)
predicted

Stepwise Selection for totalhrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 2	F-to-remove: 4.00

R-squared: .92416 Adjusted: .88625 MSE: 677250 d.f.: 10

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	4.96938	32.8124			
2. wl	54.0451	31.5327			
3. ws DIVIDE wavi	156.815	19.1014			
4. gtow	-0.01428	16.8802			
5. wavi	0.87475	8.8128			

Model fitting results for: totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-9300.697159	1377.000197	-6.7543	0.0001
vmaxa	4.969379	0.867528	5.7282	0.0002
wl	54.045094	9.624444	5.6154	0.0002
ws DIVIDE wavi	156.815223	35.880272	4.3705	0.0014
gtow	-0.01428	0.003476	-4.1085	0.0021
wavi	0.874754	0.294665	2.9686	0.0141

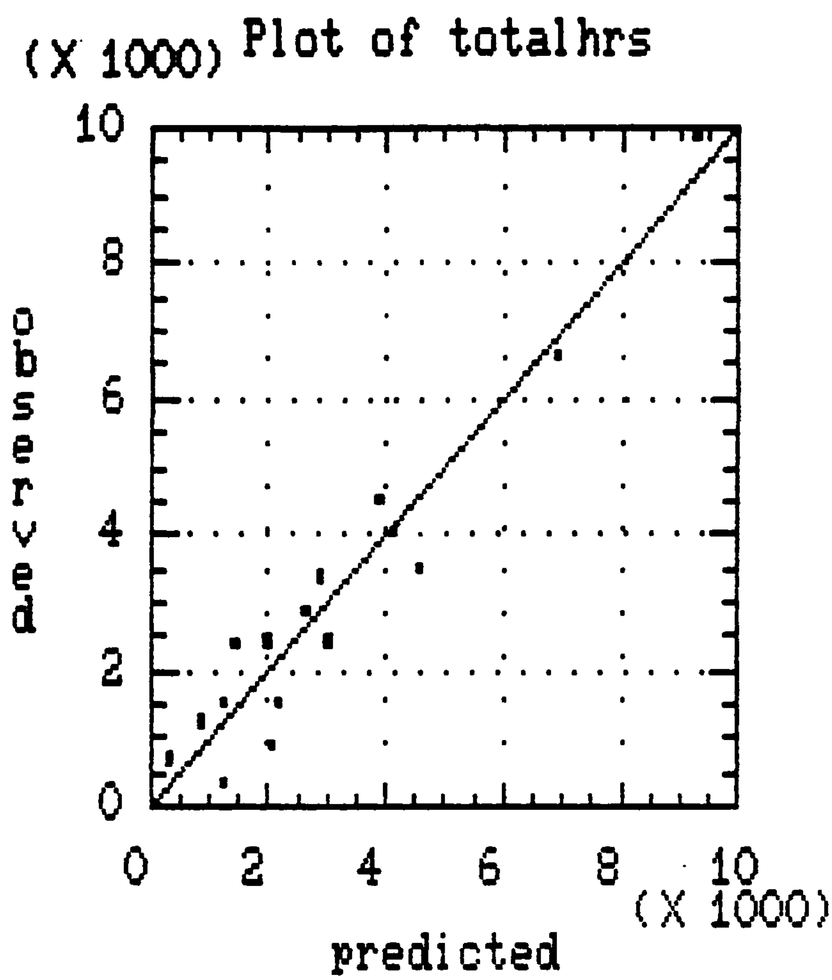
R-SQ. (ADJ.) =	0.8862	SE=	822.951850	MAE=	577.829045	DurbWat=	2.369
Previously:	0.0000		0.000000		0.000000		0.000

16 observations fitted, forecast(s) computed for 8 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	82532342.	5	16506468.	24.3728	.0000
Error	6772497.	10	677250.		
Total (Corr.)	89304839.	15			

R-squared = 0.924164 Stnd. error of est. = 822.952
R-squared (Adj. for d.f.) = 0.886246 Durbin-Watson statistic = 2.3691



(X 1000) Plot of totalhrs
10
8
6
4
2
0
observed
0
2
4
6
8
10
(X 1000)
predicted

Stepwise Selection for totalhrs

Selection: Backward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 3	F-to-remove: 4.00

R-squared: .74445 Adjusted: .63797 MSE: 3.49019E6 d.f.: 12

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	6.67724	15.9442	5. ff	.0811	.0728
2. wl	46.0690	4.9906	6. gtow	.1020	.1156
3. wavu	2.29306	10.5702	7. we DIVIDE wavi	.3706	1.7509
4. we	-0.04799	7.8223			
8. ws DIVIDE wavi	234.509	9.5858			

Model fitting results for: totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1.191286E4	3036.321909	-3.9235	0.0020
vmaxa	6.677243	1.672231	3.9930	0.0018
wl	46.069036	20.622153	2.2340	0.0453
wavu	2.293064	0.7053	3.2512	0.0069
we	-0.047986	0.017157	-2.7968	0.0161
ws DIVIDE wavi	234.508931	75.74366	3.0961	0.0093

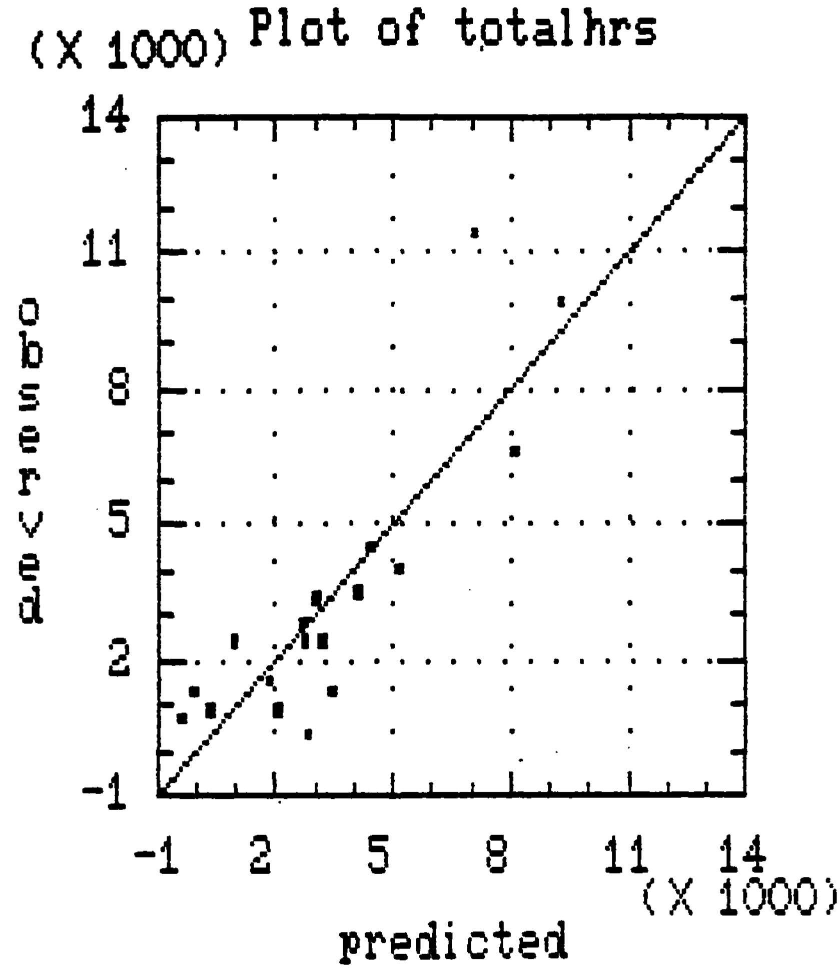
R-SQ. (ADJ.) = 0.6380	SE=	1868.205589	MAE=	1131.250970	DurbWat=	2.332
Previously: 0.0000		0.000000		0.000000		0.000

18 observations fitted, forecast(s) computed for 4 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	122010310.	5	24402062.	6.99161	.0028
Error	41882305.	12	3490192.		
Total (Corr.)	163892615.	17			

R-squared = 0.744453 Stnd. error of est. = 1868.21
R-squared (Adj. for d.f.) = 0.637975 Durbin-Watson statistic = 2.33243


Plot of totalhrs
(X 1000)
14
11
8
5
2
-1
observed
-1
2
5
8
11
14
(X 1000)
predicted

Model fitting results for: totalhrs

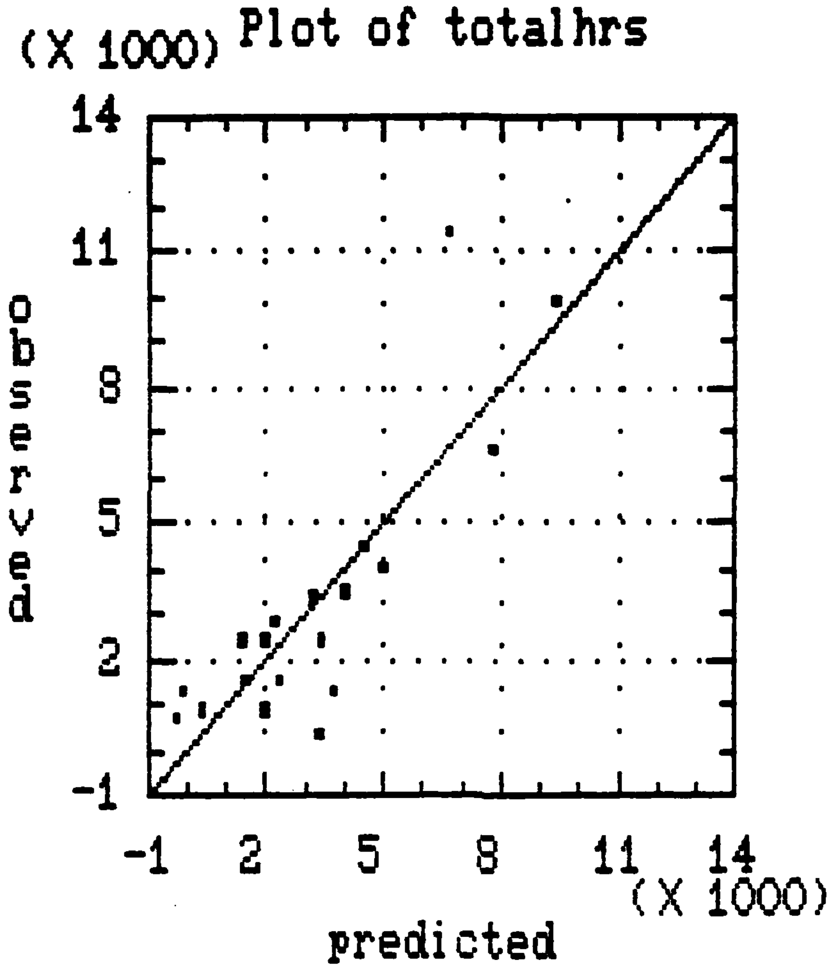
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1.147354E4	3148.144654	-3.6445	0.0030
vmaxa	7.064267	1.70583	4.1412	0.0012
wl	42.037725	20.760173	2.0249	0.0639
ws DIVIDE wavi	219.724726	78.772184	2.7894	0.0153
we	-0.048325	0.018965	-2.5482	0.0243
wavi	1.600989	0.552012	2.9003	0.0124

R-SQ. (ADJ.) = 0.6008 SE= 1924.645484 MAE= 1128.024872 DurbWat= 2.794
Previously: 0.0000 0.000000 0.000000 0.000
19 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	118866336.	5	23773267.	6.41782	.0033
Error	48155383.	13	3704260.		
Total (Corr.)	167021719.	18			

R-squared = 0.711682 Stnd. error of est. = 1924.65
R-squared (Adj. for d.f.) = 0.60079 Durbin-Watson statistic = 2.79406


Plot of totalhrs
(X 1000)
14
11
8
5
2
-1
observed
-1
2
5
8
11
14
(X 1000)
predicted

Model fitting results for: totalhrs

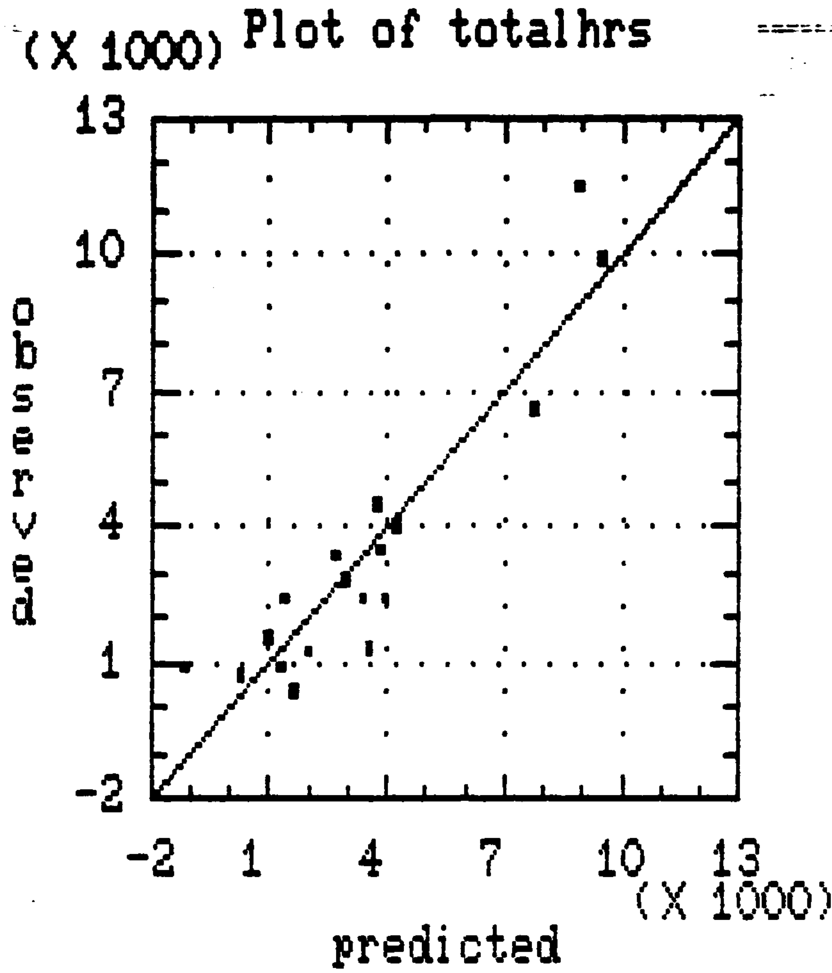
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1.077698E4	3383.833165	-3.1848	0.0111
vmaxa	7.539102	1.781093	4.2329	0.0022
wl	46.55265	20.553606	2.2649	0.0498
wavu	2.576484	0.800791	3.2174	0.0105
we DIVIDE wavi	-407.440752	172.078252	-2.3678	0.0421
we	-0.243616	0.108182	-2.2519	0.0508
ff	-29.563053	72.889472	-0.4056	0.6945
gtow	0.060143	0.036311	1.6563	0.1320
ws DIVIDE wavi	992.657877	332.812353	2.9826	0.0154

R-SQ. (ADJ.) = 0.7060 SE= 1683.511947 MAE= 963.114854 DurbWat= 2.596
Previously: 0.0000 0.000000 0.000000 0.000
18 observations fitted, forecast(s) computed for 4 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	138384703.	8	17298088.	6.10331	.0069
Error	25507912.	9	2834212.		
Total (Corr.)	163892615.	17			

R-squared = 0.844362 Stnd. error of est. = 1683.51
R-squared (Adj. for d.f.) = 0.706017 Durbin-Watson statistic = 2.59577


Plot of totalhrs
(X 1000)
13
10
7
4
1
-2
observed
-2
1
4
7
10
13
(X 1000)
predicted

Model fitting results for: totalhrs

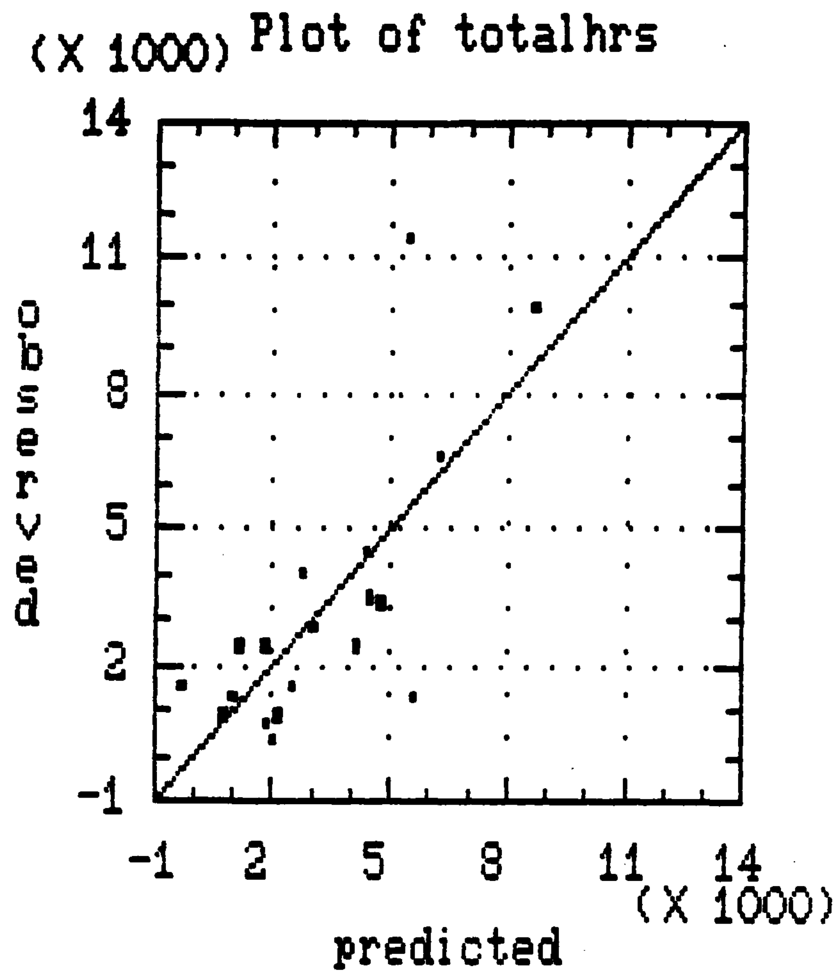
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-4966.2844	3144.648299	-1.5793	0.1383
vmaxa	6.003015	2.1484	2.7942	0.0152
wl	32.998473	25.591643	1.2894	0.2197
ws DIVIDE wavi	23.604575	56.384542	0.4186	0.6823
gtow	-0.000798	0.00478	-0.1670	0.8699
cq	-965.452538	1271.433844	-0.7593	0.4612

R-SQ. (ADJ.) = 0.3701 SE= 2417.689738 MAE= 1407.425309 DurbWat= 2.073
Previously: 0.0000 0.000000 0.000000 0.000
19 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	91033811.	5	18206762.	3.11481	.0458
Error	75987908.	13	5845224.		
Total (Corr.)	167021719.	18			

R-squared = 0.545042 Stnd. error of est. = 2417.69
R-squared (Adj. for d.f.) = 0.370058 Durbin-Watson statistic = 2.07341



Plot of totalhrs
(X 1000)
14
11
8
5
2
-1
observed
-1
2
5
8
11
14
(X 1000)
predicted

Stepwise Selection for totalhrs

Selection: Backward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 1	F-to-remove: 4.00

R-squared: .79187	Adjusted: .67834	MSE: 3.10099E6	d.f.: 11

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	6.99089	20.6238	7. cq	.0658	.0435
2. ws DIVIDE wavi	145.229	4.0321			
3. wavu	1.61572	5.0800			
4. gtow	-0.01673	7.3714			
5. weows	-7687.24	7.2815			
6. gtowows	1108.63	4.0873			

Model fitting results for: totalhrs

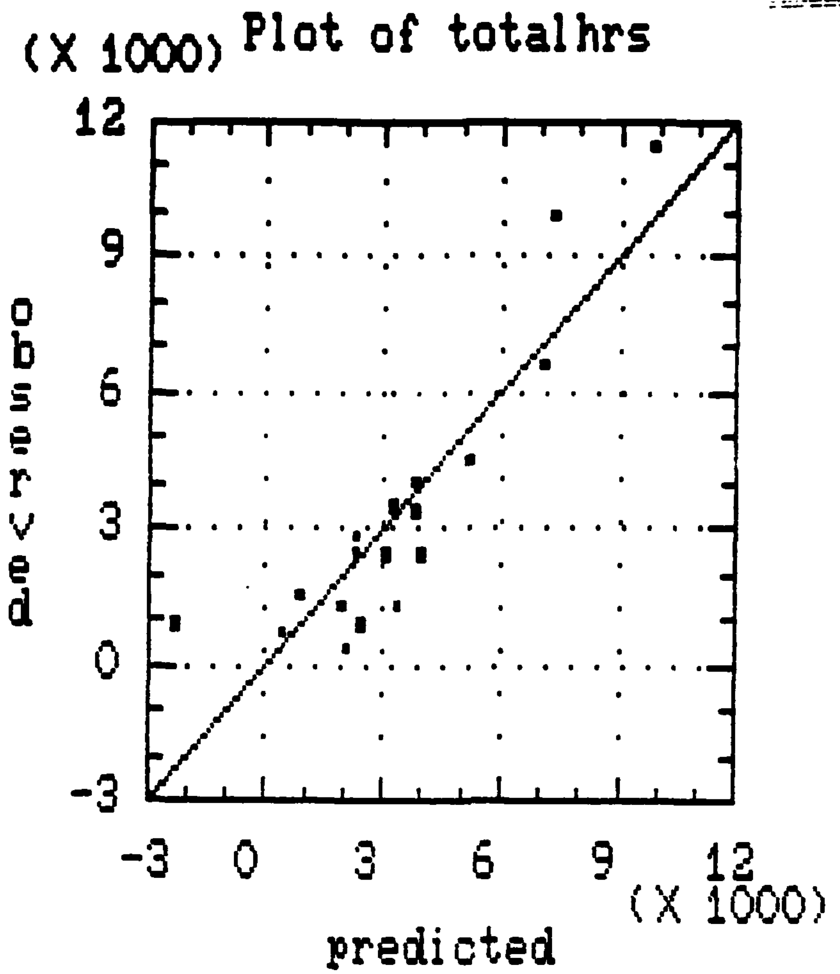
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	4414.960281	6371.611386	0.6929	0.5027
vmaxa	6.990887	1.539388	4.5413	0.0008
ws DIVIDE wavi	145.229295	72.324928	2.0080	0.0698
wavu	1.615719	0.716861	2.2539	0.0456
gtow	-0.016729	0.006162	-2.7150	0.0201
weows	-7687.240688	2848.782698	-2.6984	0.0207
gtowows	1108.633655	548.367505	2.0217	0.0682

R-SQ. (ADJ.) = 0.6783 SE= 1760.963833 MAE= 1067.911642 DurbWat= 2.201
Previously: 0.9073 986.430249 609.756674 2.240
18 observations fitted, forecast(s) computed for 4 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	129781685.	6	21630281.	6.97527	.0030
Error	34110930.	11	3100994.		
Total (Corr.)	163892615.	17			

R-squared = 0.79187 Stnd. error of est. = 1760.96
R-squared (Adj. for d.f.) = 0.678345 Durbin-Watson statistic = 2.20112



(X 1000) Plot of totalhrs
12
9
6
3
0
-3
observed
-3
0
3
6
9
12
(X 1000)
predicted

Model fitting results for: totalhrs

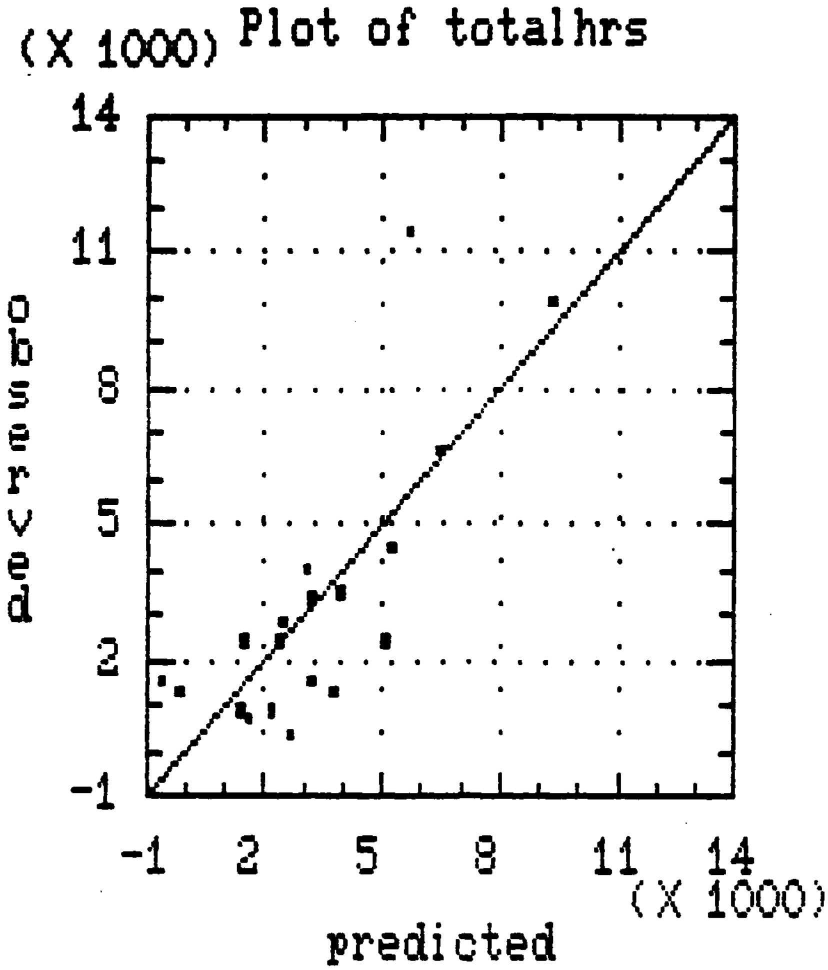
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-5385.623196	2834.875627	-1.8998	0.0799
vmaxa	5.653046	2.029718	2.7851	0.0155
wl	49.042364	26.462688	1.8533	0.0867
ws DIVIDE wavi	28.888184	51.854799	0.5571	0.5869
gtow	-0.00159	0.0045	-0.3532	0.7296
ff	-104.436616	66.999514	-1.5588	0.1431

R-SQ. (ADJ.) = 0.4457 SE= 2267.861733 MAE= 1349.153035 DurbWat= 2.503
Previously: 0.0000 0.000000 0.000000 0.000
19 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	100160160.	5	20032032.	3.89486	.0223
Error	66861559.	13	5143197.		
Total (Corr.)	167021719.	18			

R-squared = 0.599683 Stnd. error of est. = 2267.86
R-squared (Adj. for d.f.) = 0.445716 Durbin-Watson statistic = 2.50286


(X 1000)
Plot of totalhrs
14
11
8
5
2
-1
observed
-1
2
5
8
11
14
(X 1000)
predicted

Model fitting results for: totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-5741.815982	2748.137258	-2.0893	0.0569
vmaxa	5.458323	1.982469	2.7533	0.0164
wl	50.908485	25.537522	1.9935	0.0676
ws DIVIDE wavi	29.270494	50.323741	0.5816	0.5708
gtow	-0.002188	0.004418	-0.4951	0.6288
ff RAISE 2	-3.894643	2.120978	-1.8362	0.0893

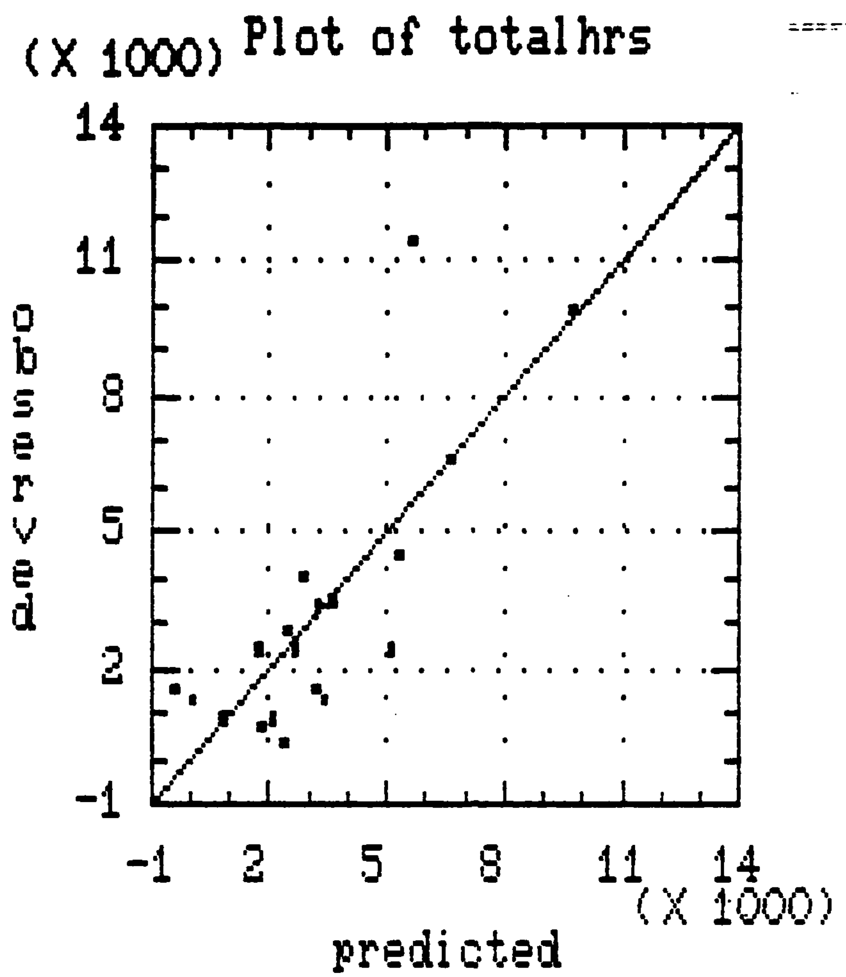
R-SQ. (ADJ.) = 0.4776 SE= 2201.647296 MAE= 1240.300951 DurbWat= 2.549
Previously: 0.0000 0.000000 0.000000 0.000
19 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	104007459.	5	20801492.	4.29140	.0159
Error	63014261.	13	4847251.		
Total (Corr.)	167021719.	18			

R-squared = 0.622718 Stnd. error of est. = 2201.65
R-squared (Adj. for d.f.) = 0.47761 Durbin-Watson statistic = 2.5485

Plot of totalhrs



Model fitting results for: totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1.008728E4	3137.053076	-3.2155	0.0092
vmaxa	9.338453	1.839435	5.0768	0.0005
wl	28.362929	20.576164	1.3784	0.1981
wavu	1.895789	0.70721	2.6807	0.0231
we DIVIDE wavi	150.108292	46.354616	3.2383	0.0089
we	-0.040676	0.013158	-3.0914	0.0114
thrust DIVIDE gtow	-1.094131E4	3508.578638	-3.1184	0.0109
ff	190.285517	94.305322	2.0178	0.0712

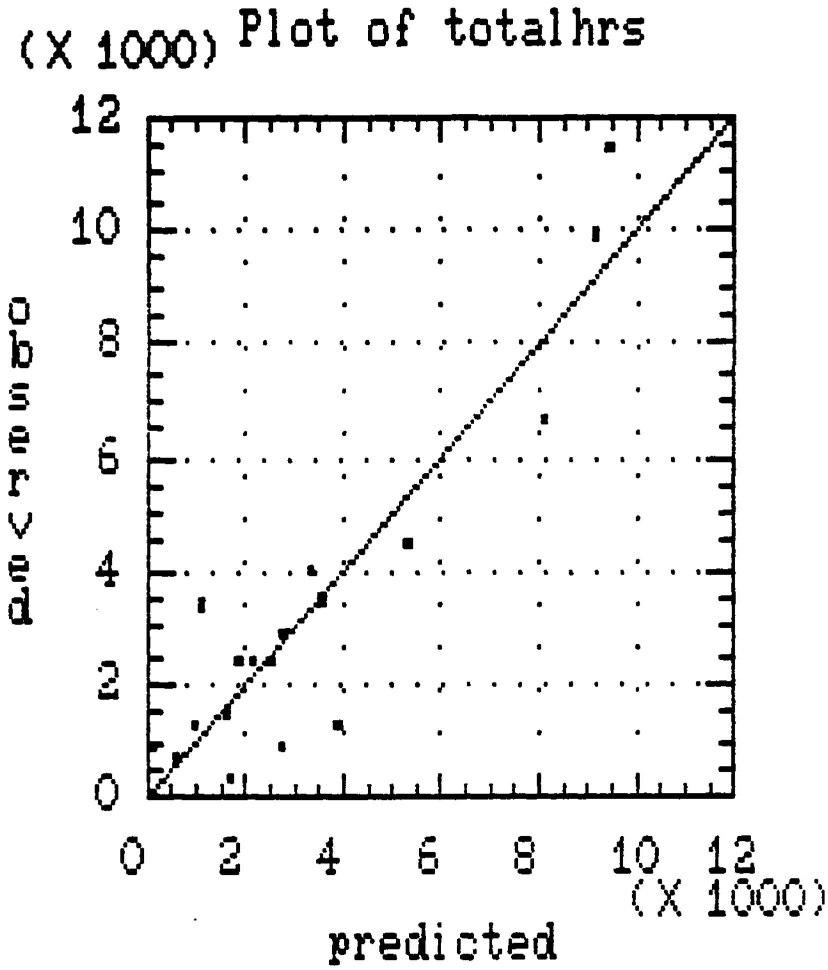
R-SQ. (ADJ.) = 0.7291 SE= 1616.030773 MAE= 902.049649 DurbWat= 2.861
Previously: 0.0000 0.000000 0.000000 0.000
18 observations fitted, forecast(s) computed for 4 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	137777061.	7	19682437.	7.53667	.0025
Error	26115555.	10	2611555.		
Total (Corr.)	163892615.	17			

R-squared = 0.840654
R-squared (Adj. for d.f.) = 0.729113

Stnd. error of est. = 1616.03
Durbin-Watson statistic = 2.861


(X 1000) Plot of totalhrs
12
10
8
6
4
2
0
observed
0
2
4
6
8
10
12
(X 1000)
predicted

Model fitting results for: totalhrs

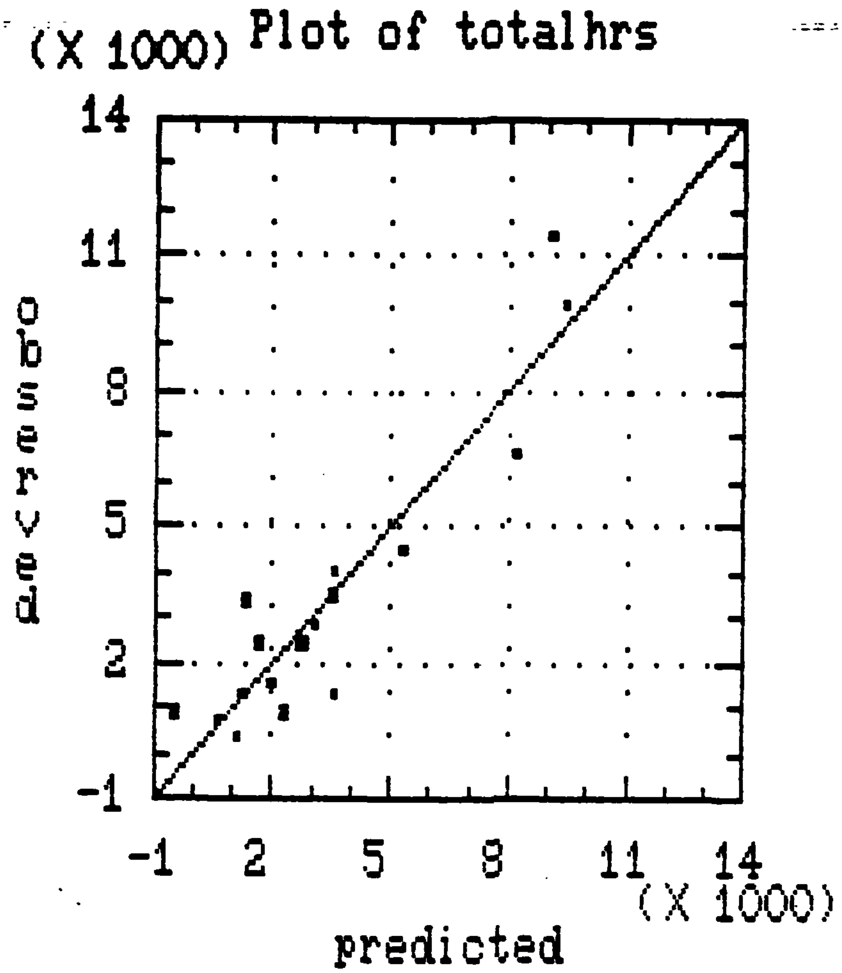
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-9813.6704	2863.161766	-3.4276	0.0065
vmaxa	8.694981	1.66529	5.2213	0.0004
wl	33.215811	19.614328	1.6934	0.1212
wavu	2.121268	0.709265	2.9908	0.0136
ws DIVIDE wavi	260.320297	73.636122	3.5352	0.0054
we	-0.055863	0.016039	-3.4830	0.0059
thrust DIVIDE gtow	-8589.128032	3137.092016	-2.7379	0.0209
ff	126.039147	78.127578	1.6132	0.1378

R-SQ. (ADJ.) = 0.7533 SE= 1542.096194 MAE= 867.476921 DurbWat= 2.692
Previously: 0.0000 0.000000 0.000000 0.000
18 observations fitted, forecast(s) computed for 4 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	140112009.	7	20016001.	8.41694	.0016
Error	23780607.	10	2378061.		
Total (Corr.)	163892615.	17			

R-squared = 0.854901 Stnd. error of est. = 1542.1
R-squared (Adj. for d.f.) = 0.753332 Durbin-Watson statistic = 2.69151


Plot of totalhrs
(X 1000)
14
11
8
5
2
-1
observed
-1
2
5
8
11
14
(X 1000)
predicted

Stepwise Selection for LOG TACAIR.totalhrs

Selection: Backward	**Maximum steps: 500**	**F-to-enter: 4.00**	
Control: Manual	**Step: 2**	**F-to-remove: 4.00**	
R-squared: .98415	**Adjusted: .96830**	**MSE: 0.0214077**	**d.f.: 5**

Variables in Model	**Coeff.**	**F-Remove**	**Variables Not in Model**	**P.Corr.**	**F-Enter**
1. LOG TACAIR.vmax	0.69923	31.3357	5. LOG TACAIR.weow	.3518	.5649
2. LOG TACAIR.ws/L	18.7550	25.2687	7. LOG TACAIR.serc	.1047	.0443
3. LOG TACAIR.wavu	2.42565	21.5854			
4. LOG TACAIR.gtow	-17.0349	22.1357			
6. LOG TACAIR.gtow	17.1285	21.5176			

Model fitting results for: LOG TACAIR.totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	6.874211	2.94801	2.3318	0.0671
LOG TACAIR.vmaxa	0.699229	0.124911	5.5978	0.0025
LOG TACAIR.ws/LOG wavi	18.754967	3.730998	5.0268	0.0040
LOG TACAIR.wavu	2.425654	0.522095	4.6460	0.0056
LOG TACAIR.gtow	-17.03489	3.620704	-4.7049	0.0053
LOG TACAIR.gtowows	17.128471	3.692506	4.6387	0.0056

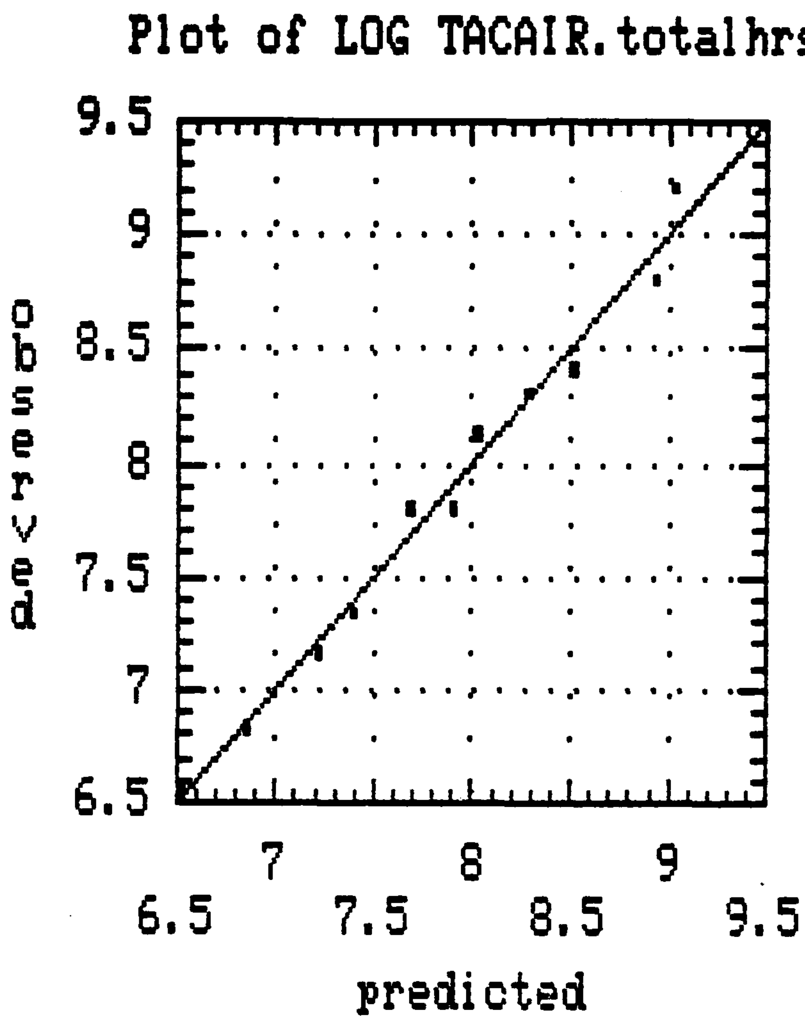
R-SQ. (ADJ.) = 0.9683	SE= 0.146314	MAE= 0.087641	DurbWat= 2.870
Previously: 0.0000	0.000000	0.000000	0.000

11 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	6.64717	5	1.32943	62.1007	.0002
Error	0.107039	5	0.0214077		
Total (Corr.)	6.75421	10			

R-squared = 0.984152 Stnd. error of est. = 0.146314
R-squared (Adj. for d.f.) = 0.968305 Durbin-Watson statistic = 2.8699


Plot of LOG TACAIR.totalhrs
9.5
9
8.5
8
7.5
7
6.5
observed
7
8
9
6.5
7.5
8.5
9.5
predicted

Stepwise Selection for LOG totalhrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 2	F-to-remove: 4.00

R-squared: .91951 Adjusted: .90341 MSE: 0.0636581 d.f.: 10

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. LOG vmaxa	0.81513	15.5149	2. LOG wl	.1361	.1699
3. LOG ws DIVIDE L	1.17652	43.4467	4. LOG we	.0584	.0308

Model fitting results for: LOG totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-6.321636	1.345547	-4.6982	0.0008
LOG vmaxa	0.815134	0.206945	3.9389	0.0028
LOG ws DIVIDE LOG wavi	1.176524	0.178494	6.5914	0.0001

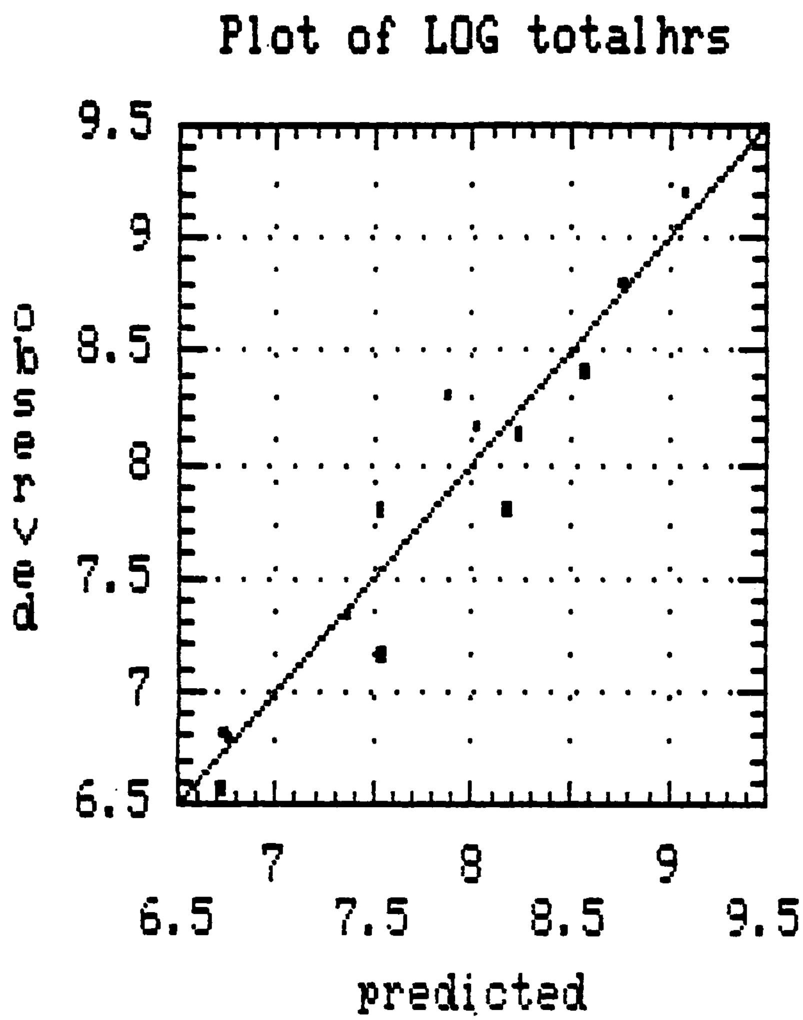
R-SQ. (ADJ.) = 0.9034	SE=	0.252306	MAE=	0.176933	DurbWat=	1.817
Previously: 0.8864		0.273619		0.184449		2.196

13 observations fitted, forecast(s) computed for 9 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	7.27197	2	3.63598	57.1174	.0000
Error	0.636581	10	0.0636581		
Total (Corr.)	7.90855	12			

R-squared = 0.919507 Stnd. error of est. = 0.252306
R-squared (Adj. for d.f.) = 0.903409 Durbin-Watson statistic = 1.81723


Plot of LOG totalhrs
9.5
9
8.5
8
7.5
7
6.5
observed
7
8
9
6.5
7.5
8.5
9.5
predicted

Stepwise Selection for totalhrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00	
Control: Manual	Step: 4	F-to-remove: 4.00	
R-squared: .95398	Adjusted: .93097	MSE: 480629	d.f.: 8

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	2.33585	7.4979			
2. wl	30.9369	13.6181			
3. ws DIVIDE wavi	101.317	20.9875			
4. we	0.14790	24.1840			

Model fitting results for: totalhrs

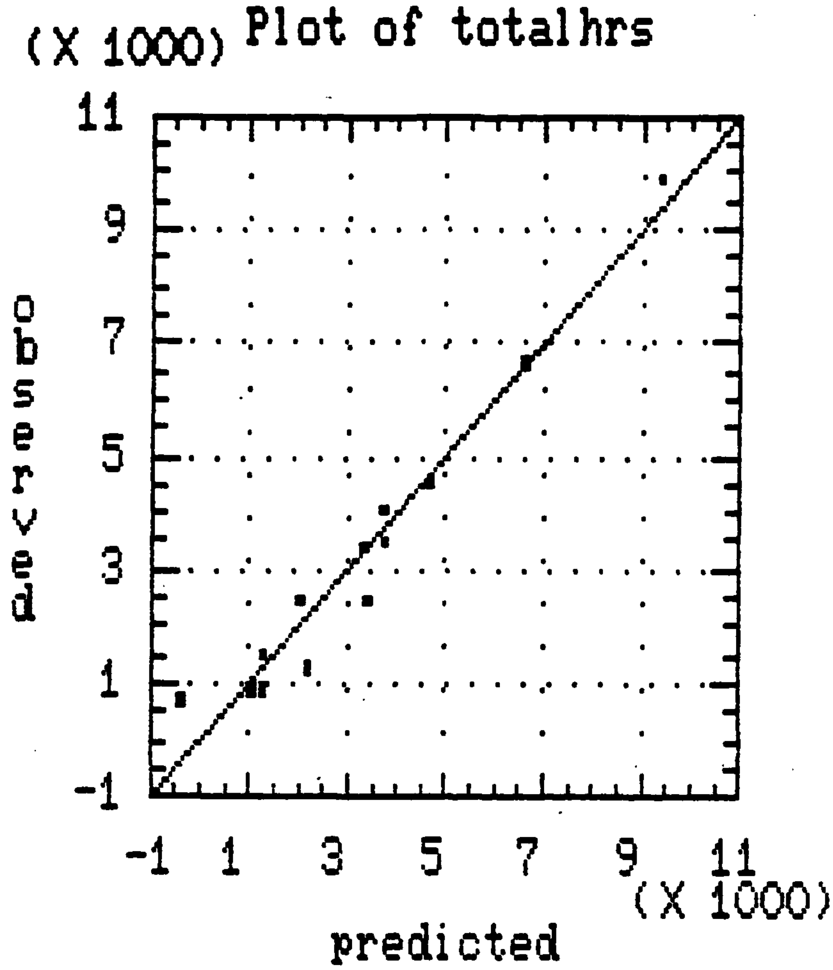
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-6765.355351	983.580912	-6.8783	0.0001
vmaxa	2.335848	0.853053	2.7382	0.0255
wl	30.936863	8.383352	3.6903	0.0061
ws DIVIDE wavi	101.316795	22.115742	4.5812	0.0018
we	0.147903	0.030076	4.9177	0.0012

R-SQ. (ADJ.) = 0.9310 SE= 693.273796 MAE= 422.562358 DurbWat= 1.256
Previously: 0.9299 698.587123 417.243790 1.346
13 observations fitted, forecast(s) computed for 9 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	79705877.	4	19926469.	41.4592	.0000
Error	3845028.	8	480629.		
Total (Corr.)	83550906.	12			

R-squared = 0.95398 Stnd. error of est. = 693.274
R-squared (Adj. for d.f.) = 0.93097 Durbin-Watson statistic = 1.25585


Plot of totalhrs
(X 1000)
11
9
7
5
3
1
-1
observed
-1 1 3 5 7 9 11
(X 1000)
predicted

Model fitting results for: LOG totalhrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-6.339618	1.689781	-3.7517	0.0072
LOG vmaxa	0.775971	0.234725	3.3059	0.0130
LOG wl	0.360059	0.393167	0.9158	0.3902
LOG ws DIVIDE LOG wavi	1.251752	0.559645	2.2367	0.0604
LOG we	0.315797	0.717507	0.4401	0.6731
LOG gtow	-0.476118	0.483354	-0.9850	0.3574

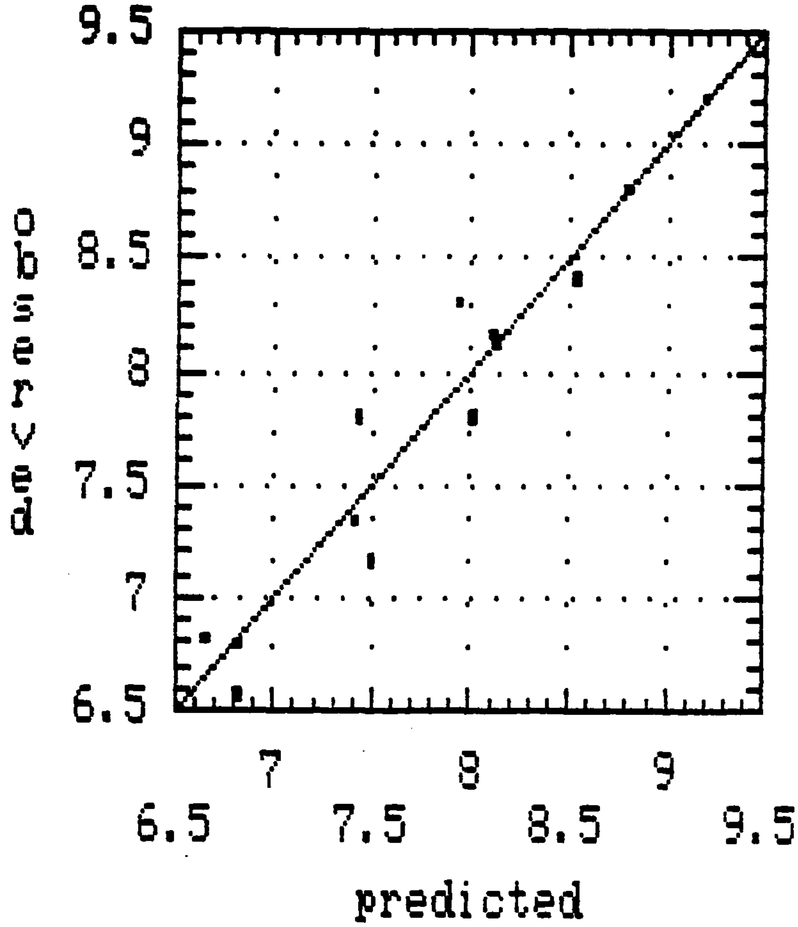
R-SQ. (ADJ.) = 0.8829 SE= 0.277782 MAE= 0.151160 DurbWat= 2.151
Previously: 0.9034 0.252306 0.176933 1.817
13 observations fitted, forecast(s) computed for 9 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	7.36841	5	1.47368	19.0983	.0006
Error	0.540141	7	0.0771631		
Total (Corr.)	7.90855	12			

R-squared = 0.931702 Stnd. error of est. = 0.277782
R-squared (Adj. for d.f.) = 0.882917 Durbin-Watson statistic = 2.15053

Plot of LOG totalhrs



Model fitting results for: totalhrs

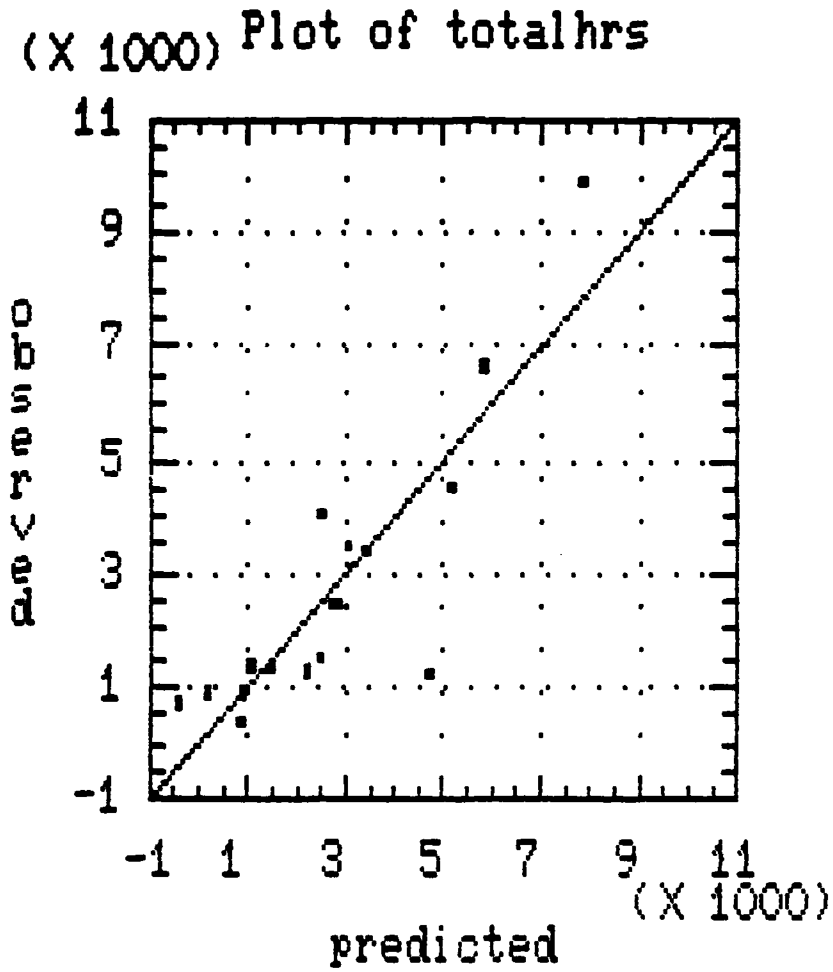
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1696.690309	1845.018323	-0.9196	0.3794
wl	13.233161	19.357693	0.6836	0.5097
we	0.268227	0.136831	1.9603	0.0784
gtow	-0.036665	0.062259	-0.5889	0.5690
ff	-29.825079	61.67896	-0.4836	0.6391
crew	-485.906955	708.258672	-0.6861	0.5083
thrust	-0.0023	0.070846	-0.0325	0.9747

R-SQ. (ADJ.) = 0.6070 SE= 1557.048481 MAE= 848.770571 DurbWat= 3.092
Previously: 0.0000 0.000000 0.000000 0.000
17 observations fitted, forecast(s) computed for 7 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	74453699.	6	12408950.	5.11836	.0119
Error	24244000.	10	2424400.		
Total (Corr.)	98697698.	16			

R-squared = 0.754361 Stnd. error of est. = 1557.05
R-squared (Adj. for d.f.) = 0.606978 Durbin-Watson statistic = 3.09212


(X 1000) Plot of totalhrs
11
9
7
5
3
1
-1
observed
-1 1 3 5 7 9 11
(X 1000)
predicted

Model fitting results for: LOG NAVAIR.enghrs

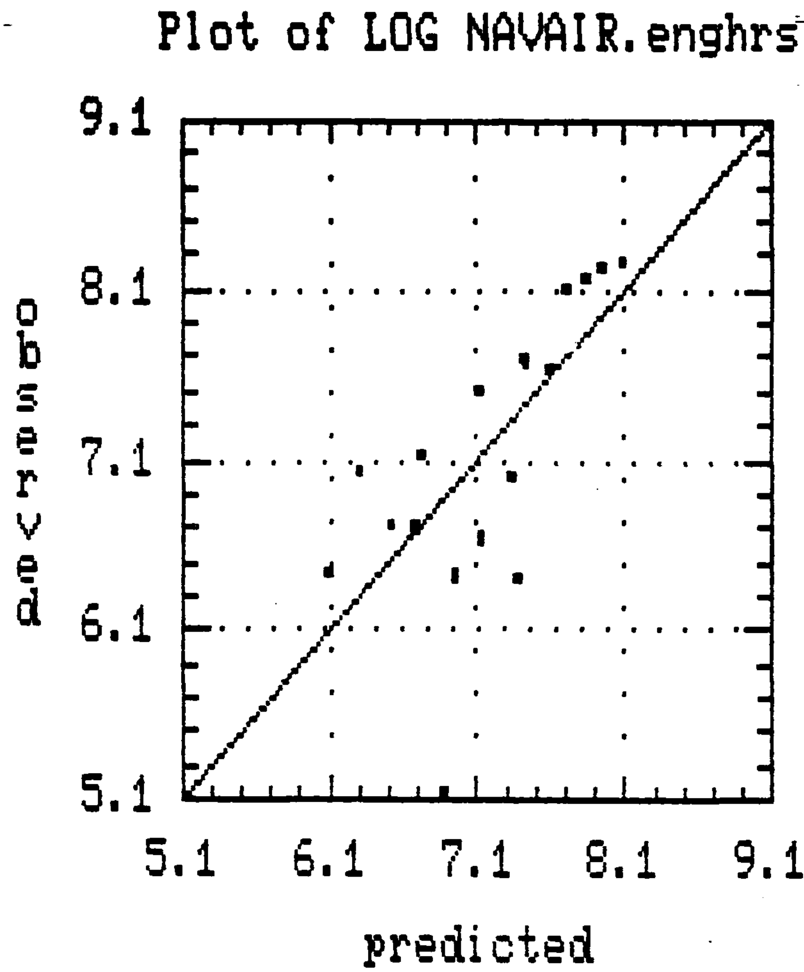
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	0.231436	2.452182	0.0944	0.9261
LOG NAVAIR.weows	-2.666201	1.079392	-2.4701	0.0260
LOG NAVAIR.vmaxa	1.285233	0.385039	3.3379	0.0045

R-SQ. (ADJ.) = 0.4073 SE= 0.633723 MAE= 0.441969 DurbWat= 2.332
Previously: 0.6917 0.350327 0.238806 2.077
18 observations fitted, forecast(s) computed for 6 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	5.49564	2	2.74782	6.84211	.0077
Error	6.02407	15	0.401605		
Total (Corr.)	11.5197	17			

R-squared = 0.477064 Stnd. error of est. = 0.633723
R-squared (Adj. for d.f.) = 0.40734 Durbin-Watson statistic = 2.33171


Plot of LOG NAVAIR.enghrs
9.1
8.1
7.1
6.1
5.1
observed
5.1
6.1
7.1
8.1
9.1
predicted

Stepwise Selection for enghrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 3	F-to-remove: 4.00

R-squared: .91470 Adjusted: .87814 MSE: 136185 d.f.: 7

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. ws	0.23374	20.4361	2. we	.3010	.5976
3. gtow	-0.04050	7.9813	4. we DIVIDE ws	.0421	.0107
6. vmaxa	1.72672	15.6414	5. gtowows	.6135	3.6217
			7. vmaxs	.3278	.7226
			8. vcruise	.3501	.8382

Model fitting results for: enghrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-664.707451	339.993428	-1.9551	0.0915
ws	0.233744	0.051706	4.5206	0.0027
gtow	-0.0405	0.014336	-2.8251	0.0256
vmaxa	1.726718	0.436599	3.9549	0.0055

R-SQ. (ADJ.) =	0.8781	SE=	369.032815	MAE=	246.540949	DurbWat=	1.518
Previously:	0.0000		0.000000		0.000000		0.000

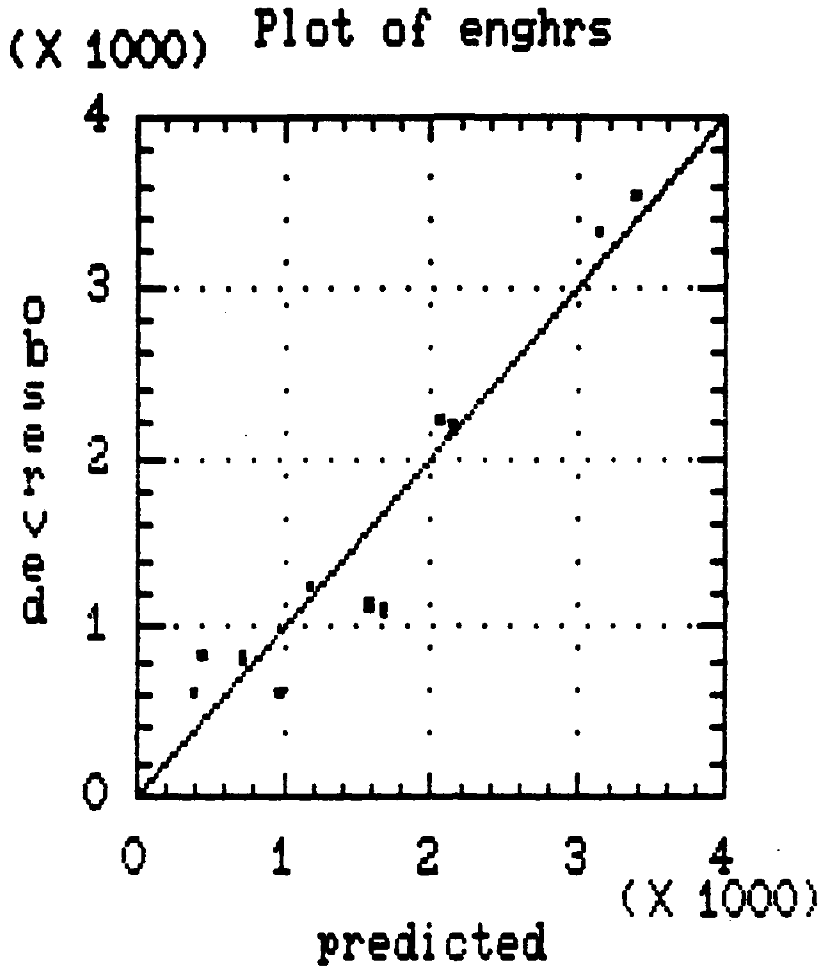
11 observations fitted, forecast(s) computed for 2 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	10222599.	3	3407533.	25.0213	.0004
Error	953297.	7	.136185.		
Total (Corr.)	11175896.	10			

R-squared = 0.914701 Stnd. error of est. = 369.033

R-squared (Adj. for d.f.) = 0.878144 Durbin-Watson statistic = 1.51797


Plot of enghrs
(X 1000)
4
3
2
1
0
observed
0
1
2
3
4
(X 1000)
predicted

Stepwise Selection for LOG enghrs

Selection: Forward   Maximum steps: 500   F-to-enter: 4.00
Control: Manual   Step: 2   F-to-remove: 4.00

R-squared: .88402   Adjusted: .80669   MSE: 0.0769604   d.f.: 6

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. LOG ws	0.86904	3.6446	4. LOG we	.1578	.1277
2. LOG gtow	-0.53820	1.6251	5. LOG we/LOG ws	.1595	.1305
3. LOG vmaxa	1.31783	9.0148	6. LOG gtowows	.1740	.1561
8. LOG vcruise	-1.33836	2.7475	7. LOG vmaxs	.1116	.0631

Model fitting results for: LOG enghrs

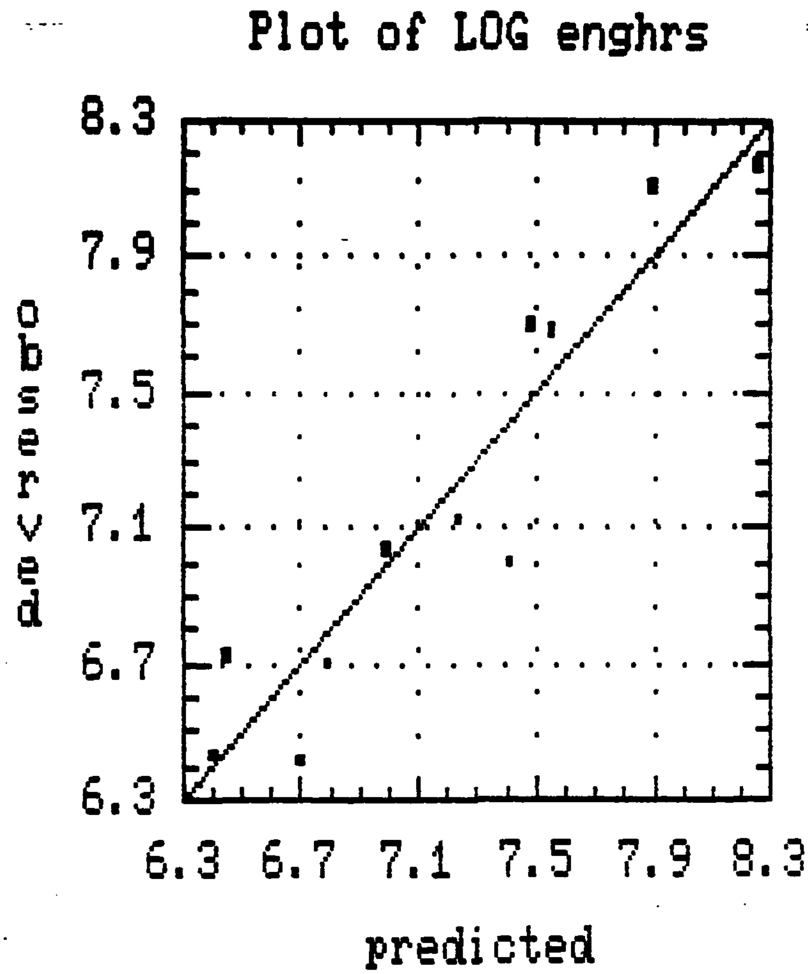
Independent variable	coefficient	std. error	t-value	sig. level
CONSTANT	4.250695	4.13965	1.0268	0.3441
LOG ws	0.869042	0.455213	1.9091	0.1048
LOG gtow	-0.538204	0.422185	-1.2748	0.2495
LOG vmaxa	1.317829	0.438916	3.0025	0.0239
LOG vcruise	-1.338361	0.807433	-1.6576	0.1485

R-SQ. (ADJ.) = 0.8067 SE= 0.277417 MAE= 0.172304 DurbWat= 2.479
Previously: 0.0000 0.000000 0.000000 0.000
11 observations fitted, forecast(s) computed for 2 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	3.51950	4	0.879874	11.4328	.0057
Error	0.461762	6	0.0769604		
Total (Corr.)	3.98126	10			

R-squared = 0.884016   Stnd. error of est. = 0.277417
R-squared (Adj. for d.f.) = 0.806693   Durbin-Watson statistic = 2.4788


Plot of LOG enghrs
8.3
7.9
7.5
7.1
6.7
6.3
observed
6.3 6.7 7.1 7.5 7.9 8.3
predicted

Stepwise Selection for enghrs

Selection: Forward		Maximum steps: 500		F-to-enter: 4.00	
Control: Manual		Step: 3		F-to-remove: 4.00	
R-squared: .70983		Adjusted: .64287	MSE: 533350	d.f.: 13	

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	3.20573	29.0995	2. wl	.2895	1.0974
6. ff	67.1994	5.2112	3. ws DIVIDE wavi	.3199	1.3680
8. thrust DIVIDE w	-2143.66	12.5099	4. wavu	.0179	.0038
			5. gtow	.1798	.4008
			7. thrust	.2148	.5805

Model fitting results for: enghrs

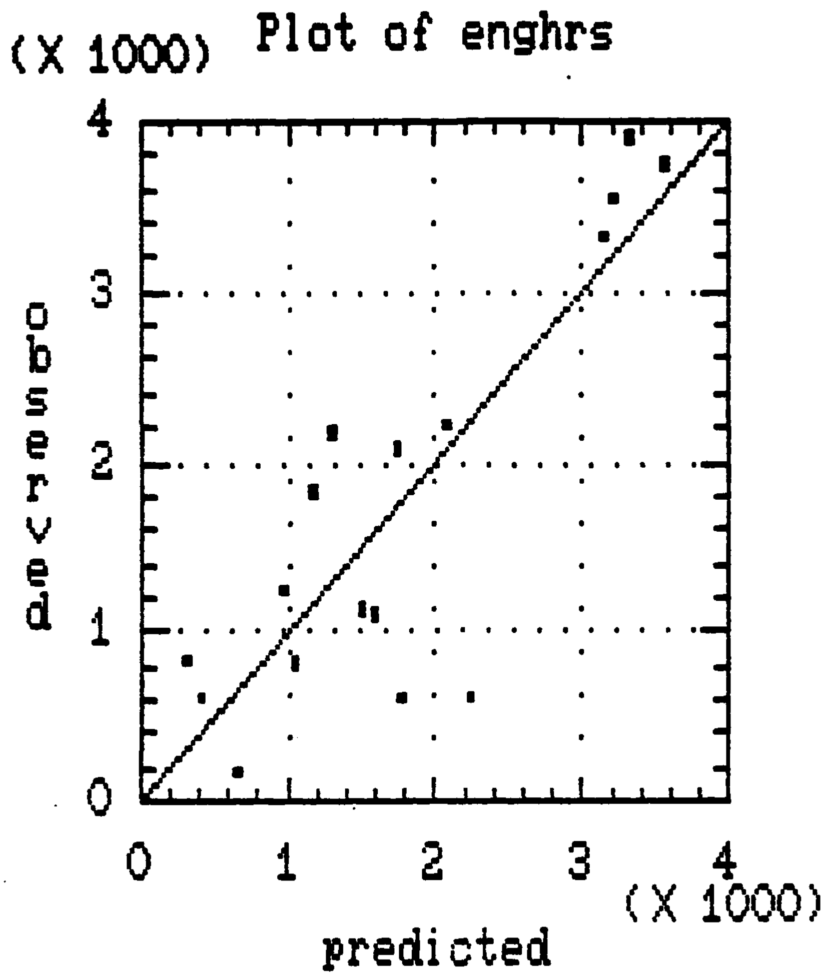
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	165.128623	571.955487	0.2887	0.7774
vmaxa	3.205728	0.59427	5.3944	0.0001
ff	67.199366	29.437158	2.2828	0.0399
thrust DIVIDE we	-2143.663629	606.079306	-3.5369	0.0036

R-SQ. (ADJ.) = 0.6429 SE= 730.308349 MAE= 510.506300 DurbWat= 1.611
Previously: 0.0000 0.000000 0.000000 0.000
17 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	16961072.	3	5653691.	10.6003	.0008
Error	6933554.	13	533350.		
Total (Corr.)	23894625.	16			

R-squared = 0.709828 Stnd. error of est. = 730.308
R-squared (Adj. for d.f.) = 0.642865 Durbin-Watson statistic = 1.61062


Plot of enghrs
(X 1000)
observed
0
1
2
3
4
0
1
2
3
4
(X 1000)
predicted

Stepwise Selection for enghrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 3	F-to-remove: 4.00

R-squared: .81668 Adjusted: .67410 MSE: 486703 d.f.: 9

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	3.31794	22.9532	8. thrust	.1442	.1699
2. ff	46.0481	2.1448			
3. thrust DIVIDE w	-1295.21	3.0962			
4. wl	9.11476	1.1207			
5. ws DIVIDE wavi	88.3058	3.7386			
6. wavu	0.64556	2.3391			
7. gtow	-0.00653	2.9320			

Model fitting results for: enghrs

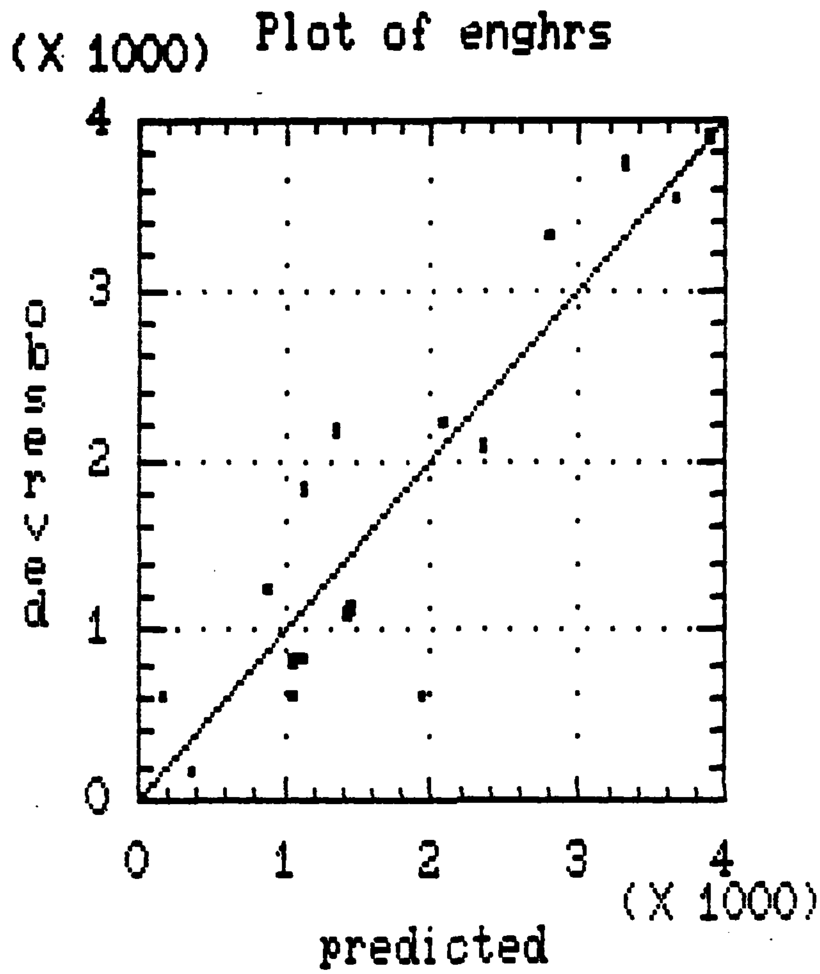
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-2939.879172	1539.874283	-1.9092	0.0886
vmaxa	3.317941	0.692544	4.7909	0.0010
ff	46.048133	31.442498	1.4645	0.1771
thrust DIVIDE we	-1295.210351	736.085357	-1.7596	0.1123
wl	9.114757	8.610058	1.0586	0.3174
ws DIVIDE wavi	88.305841	45.670681	1.9335	0.0852
wavu	0.64556	0.422098	1.5294	0.1605
gtow	-0.006531	0.003814	-1.7123	0.1210

R-SQ. (ADJ.) = 0.6741 SE= 697.640952 MAE= 407.613940 DurbWat= 2.508
Previously: 0.0000 0.000000 0.000000 0.000
17 observations fitted, forecast(s) computed for 5 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	19514299.	7	2787757.	5.72784	.0094
Error	4380326.	9	486703.		
Total (Corr.)	23894625.	16			

R-squared = 0.816682 Stnd. error of est. = 697.641
R-squared (Adj. for d.f.) = 0.674101 Durbin-Watson statistic = 2.50797



(X 1000) Plot of enghrs
4
3
2
1
0
observed
0
1
2
3
4
(X 1000)
predicted

Model fitting results for: LOG NAVAIR.enghrs

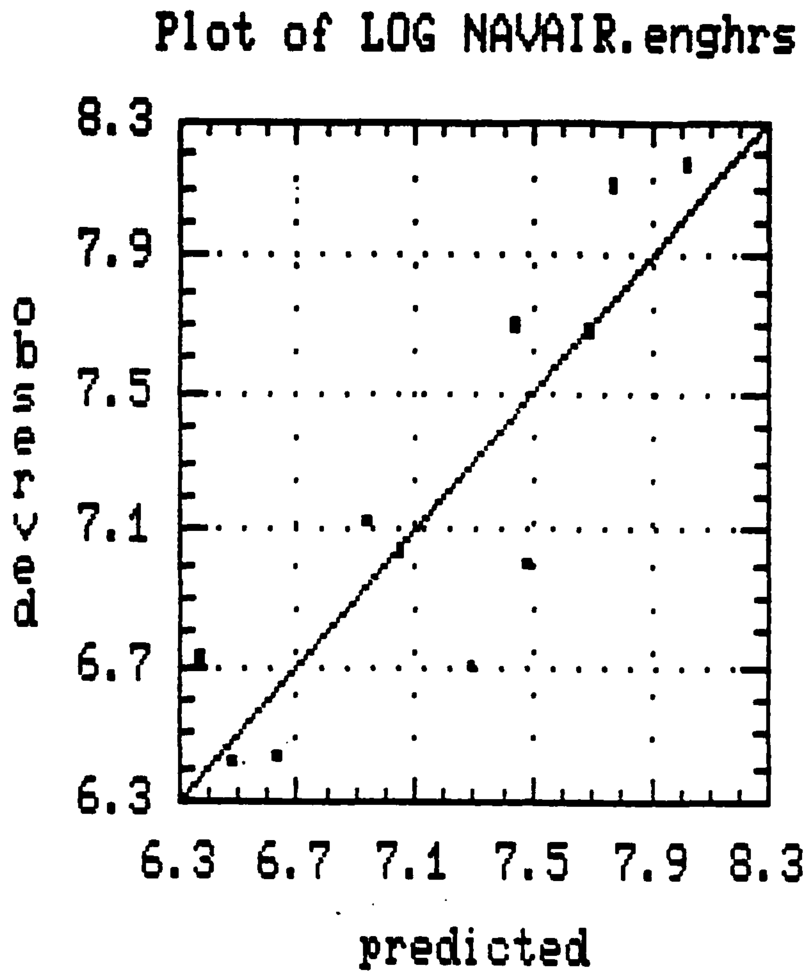
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-6.801848	3.433679	-1.9809	0.0829
LOG NAVAIR.ws	0.796297	0.190425	4.1817	0.0031
LOG NAVAIR.vmaxs	1.034254	0.494547	2.0913	0.0699

R-SQ. (ADJ.) = 0.6917 SE= 0.350327 MAE= 0.238806 DurbWat= 2.077
Previously: 0.9380 0.177965 0.132311 2.029
11 observations fitted, forecast(s) computed for 3 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	2.99943	2	1.49972	12.2198	.0037
Error	0.981830	8	0.122729		
Total (Corr.)	3.98126	10			

R-squared = 0.753387
R-squared (Adj. for d.f.) = 0.691734
Stnd. error of est. = 0.350327
Durbin-Watson statistic = 2.07705


Plot of LOG NAVAIR.enghrs
8.3
7.9
7.5
7.1
6.7
6.3
observed
6.3 6.7 7.1 7.5 7.9 8.3
predicted

Stepwise Selection for enghrs

Selection: Backward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 1	F-to-remove: 4.00

R-squared: .99853 Adjusted: .99266 MSE: 10641.1 d.f.: 2

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. vmaxa	0.72158	9.8922	3. we DIVIDE wavi	.1219	.0149
2. wl	7.85314	21.3107			
4. ws DIVIDE wavi	29.1986	7.1067			
5. wavu	0.36939	13.6414			
6. we	0.21610	156.0330			
7. gtow	-0.07261	98.5882			
8. ff	-18.2202	5.8794			
9. crew	-706.749	60.8837			

Model fitting results for: enghrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-574.336252	430.901101	-1.3329	0.3141
vmaxa	0.721582	0.229424	3.1452	0.0880
wl	7.853144	1.70116	4.6163	0.0439
ws DIVIDE wavi	29.198641	10.952899	2.6658	0.1166
wavu	0.369393	0.100014	3.6934	0.0661
we	0.216104	0.0173	12.4913	0.0063
gtow	-0.072606	0.007312	-9.9292	0.0100
ff	-18.220246	7.514298	-2.4247	0.1362
crew	-706.74891	90.576275	-7.8028	0.0160

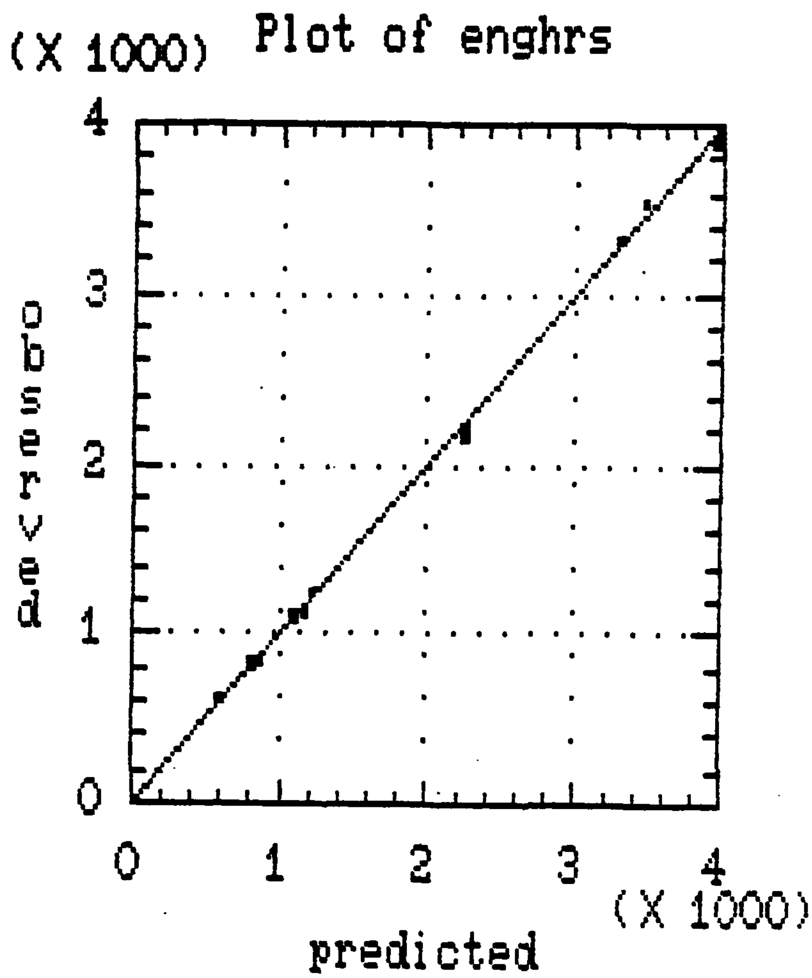
R-SQ. (ADJ.) = 0.9927	SE= 103.155852	MAE= 36.385286	DurbWat= 3.175
Previously: 0.9730	197.873714	100.886893	2.678

11 observations fitted, forecast(s) computed for 6 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	14485948.	8	1810743.	170.165	.0059
Error	21282.3	2	10641.1		
Total (Corr.)	14507230.	10			

R-squared = 0.998533 Stnd. error of est. = 103.156
R-squared (Adj. for d.f.) = 0.992665 Durbin-Watson statistic = 3.17494


Plot of enghrs
(X 1000)
4
3
2
1
0
observed
0
1
2
3
4
(X 1000)
predicted

Stepwise Selection for LOG enghrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 1	F-to-remove: 4.00

R-squared: .79223 Adjusted: .72990 MSE: 0.148068 d.f.: 10

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
1. LOG vmaxa	0.88684	7.2676	2. LOG wl	.0419	.0158
3. LOG ws/LOG wavi	2.23734	12.0092	4. LOG wavu	.1411	.1829
6. LOG gtow	-1.51740	5.8557	5. LOG we	.2859	.8014
			7. LOG crew	.3133	.9793
			8. LOG we/LOG wavi	.2886	.8177

Model fitting results for: LOG enghrs

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	1.097246	2.630871	0.4171	0.6854
LOG vmaxa	0.886838	0.328965	2.6958	0.0225
LOG ws/LOG wavi	2.237343	0.645617	3.4654	0.0061
LOG gtow	-1.517396	0.62706	-2.4199	0.0361

R-SQ. (ADJ.) = 0.7299	SE=	0.384796	MAE=	0.231345	DurbWat=	2.637
Previously: 0.2515		0.773003		0.487195		2.272

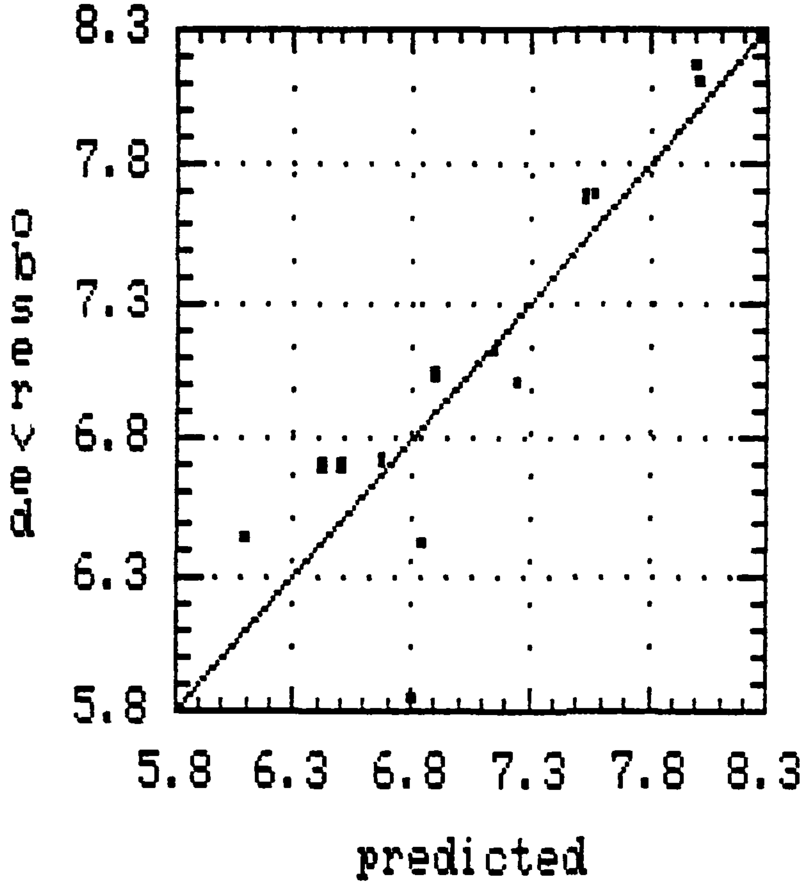
14 observations fitted, forecast(s) computed for 11 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	5.64600	3	1.88200	12.7104	.0010
Error	1.48068	10	0.148068		
Total (Corr.)	7.12669	13			

R-squared = 0.792234 Stnd. error of est. = 0.384796
R-squared (Adj. for d.f.) = 0.729904 Durbin-Watson statistic = 2.63739

Plot of LOG enghrs



Model fitting results for: enghrs

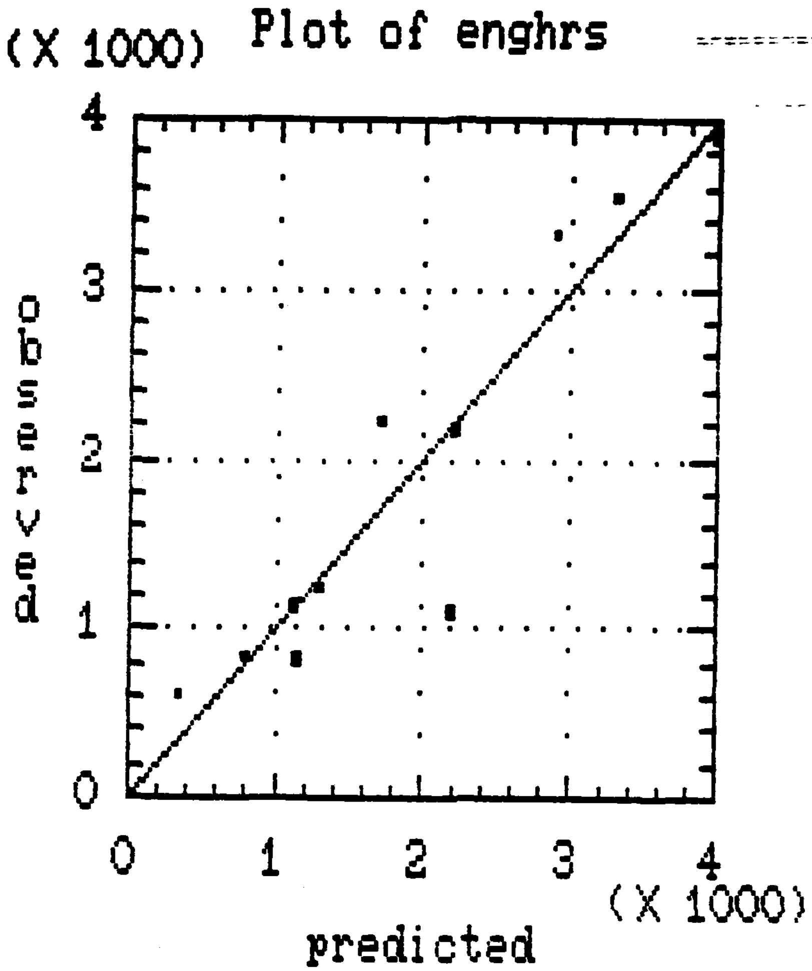
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-1796.984046	675.352982	-2.6608	0.0324
vmaxa	1.314872	0.662056	1.9860	0.0874
ws DIVIDE wavi	40.676451	25.293659	1.6082	0.1518
we	0.082504	0.0245	3.3675	0.0120

R-SQ. (ADJ.) = 0.8159 SE= 516.828624 MAE= 281.317892 DurbWat= 2.817
Previously: 0.0000 0.000000 0.000000 0.000
11 observations fitted, forecast(s) computed for 6 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	12637447.	3	4212482.	15.7705	.0017
Error	1869783.	7	267112.		
Total (Corr.)	14507230.	10			

R-squared = 0.871114 Stnd. error of est. = 516.829
R-squared (Adj. for d.f.) = 0.815877 Durbin-Watson statistic = 2.81673


Plot of enghrs
(X 1000)
4
3
2
1
0
observed
0
1
2
3
4
(X 1000)
predicted

Stepwise Selection for enghrs

Selection: Forward	Maximum steps: 500	F-to-enter: 4.00
Control: Manual	Step: 3	F-to-remove: 4.00

R-squared: .98651 Adjusted: .97301 MSE: 39154 d.f.: 5

Variables in Model	Coeff.	F-Remove	Variables Not in Model	P.Corr.	F-Enter
2. wl	8.12227	6.5471	1. vmaxa	.3713	.6396
6. we	0.25753	155.5007	3. we DIVIDE wavi	.0171	.0012
7. gtow	-0.08093	55.9442	4. ws DIVIDE wavi	.1100	.0490
8. ff	-31.1604	12.0470	5. wavu	.5678	1.9034
9. crew	-688.305	62.7862			

Model fitting results for: enghrs

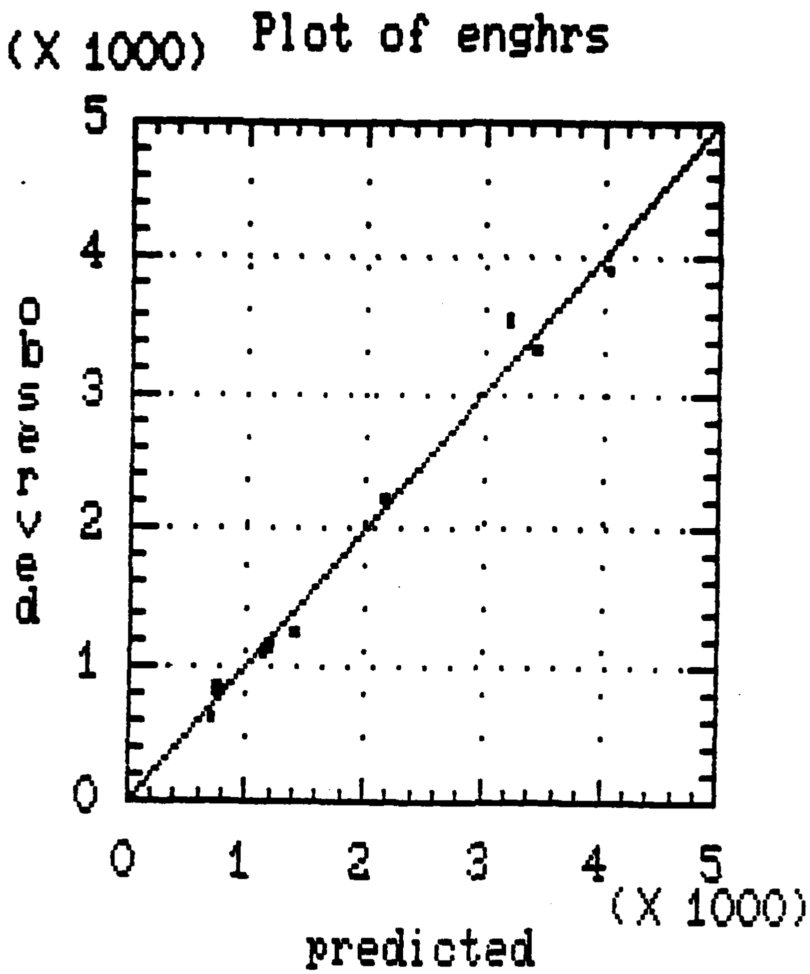
Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	427.599034	286.234759	1.4939	0.1954
wl	8.122269	3.174332	2.5587	0.0507
we	0.25753	0.020652	12.4700	0.0001
gtow	-0.080931	0.01082	-7.4796	0.0007
ff	-31.160437	8.977676	-3.4709	0.0178
crew	-688.304888	86.865819	-7.9238	0.0005

R-SQ. (ADJ.) = 0.9730 SE= 197.873714 MAE= 100.886893 DurbWat= 2.678
Previously: 0.8159 516.828624 281.317892 2.817
11 observations fitted, forecast(s) computed for 6 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	14311460.	5	2862292.	73.1034	.0001
Error	195770.	5	39154.0		
Total (Corr.)	14507230.	10			

R-squared = 0.986505 Stnd. error of est. = 197.874
R-squared (Adj. for d.f.) = 0.973011 Durbin-Watson statistic = 2.67847


Plot of enghrs
(X 1000)
5
4
3
2
1
0
observed
0
1
2
3
4
5
(X 1000)
predicted

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